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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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An Unqualified Success

No technical society has had a more propitious inauguration than The Institute of Vitreous Enamellers, which held its first annual conference at Birmingham last week-end. The programme was kept within easily-manageable proportions, and consisted of a reception, a banquet, a dance, a works visit, a technical session, and a theatre party.

The choice of Dr. J. W. Mellor as the first President was singularly fortunate, as his charming personality is combined with a profound knowledge—recognised internationally—of the kindred subjects of ceramics, chemistry and physics, and the organisation of co-operative technical activities.

The Conference very clearly described the real necessity for the creation of such an institute. Actually the work undertaken is the technical study of what has been a side-line identifiable with a number of industries of national importance—steel, cast iron and ceramics. It is now obvious that there is a real need for fundamental research so developed that it is readily interpretable by vitreous enamellers, such as the expansion and contraction of enamels related to the metals upon which they are fused. The point was well brought out by Mr. England in his Paper, which is printed elsewhere in this issue, and was the subject of much discussion, both inside the meeting and in the lobbies. Conversation with the members convinced us that there was a real desire to exchange information, and the broad-minded attitude of the directors in throwing open their vast works for inspection was a much-appreciated concrete expression of the new ideals which the Institute has set. The ship has, indeed, been well launched, and the industry owes much to Mr. Whittle, the chairman of the Institute, who has brought his considerable business experience to direct the Council along the road to success. Thanks are especially due to the Birmingham local committee, which consisted of Mr. W. Todd (of the Parkinson Stove Company), Mr. John Gardom, the well-known consulting metallurgist, and Mr. W. S. Grainger, of Stocal Enamels, Limited, who, in the comparatively short time at their disposal, organised a conference equal to the best, and superior to most, of the efforts made by technical associations. Recognition must also be accorded to the honorary secretary, Miss E. Christine Elliot, and Mr. James Gray, because it was their pioneer efforts which made this essentially successful conference possible.

A full programme of lectures has been organised for the winter sessions, to be held in London, Birmingham and Manchester, and negotiations are proceeding to cater for the Scottish enamelling industry.

Alloys of Iron Research

The review prepared by Dr. C. H. Desch for the Institution of Mechanical Engineers, of which we made an abstract in a recent issue, is an interesting survey of an investigation which goes back almost to the origin of metallurgical research in this country and one of which the Institution concerned may well be proud. The first report by Roberts-Austen was presented in 1891, and this eminent metallurgist, whose name is preserved in the term austenite, was associated with succeeding reports up to the sixth, in 1904. From 1902 the work was conducted at the National Physical Laboratory, which had been established in 1899, and such well-known names as Carpenter, Edwards and Rosenhain are associated with subsequent reports, which began to be concerned with the non-ferrous metals, the eleventh report in 1921 summarising some of the important work done on aluminium alloys during the war. It was then decided that the alloys of iron should be more fully and more systematically studied. This policy, advocated strenuously by the late Dr. Rosenhain, involved larger funds than any one institution could provide, and, largely by the energy and financial support of Sir John Dewrance, an Alloys of Iron Research Committee was formed. The new approach was dictated by many reasons. Enormous developments had been made in the production of new steels, but metallurgists lacked the fundamental data to guide them in preparing new combinations. New apparatus and methods had been evolved and there were many reasons for suspecting errors and inaccuracies in the earlier work, due to the cruder methods and apparatus then used. Most of all, however, there was a fuller realisation of the marked effect of small quantities of impurities in metals, an effect realised most fully by Rosenhain. The wisdom of working on the purest possible materials is now unreservedly accepted by metallurgists. The result has been

(*Concluded on next page.*)

C

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

The 1⅝-in dia. Test-Bar

To the Editor of The Foundry Trade Journal.

Sir,—In your issue of July 19, 1934, you quote Mr. John Shaw as saying "Many now felt that the introduction of a bar 1⅝ in. dia. would give a more correct idea of the structure and strength of a casting about that thickness."

This was particularly interesting to the writer, as it recalled a laboratory report he made some time ago, a quotation from which may be of interest.

"Prior to the publication of the B.E.S.A. Specification No. 321—1928, the writer, whilst experimenting with mixtures for high-duty work, found it necessary to adopt round test-bars to avoid the chill which invariably occurred in the (then) standard rectangular bars. The size finally selected was 1.655 in. dia. (1⅝ in. for practical purposes) on a span of 24 in., which should theoretically break at the same loads as the 2-in. by 1-in. by 36-in. bar, thus giving results in terms familiar to all concerned—a point of importance in the foundry where, as a rule, strength is considered in terms of the 2-in. by 1-in. bar.

"Since the B.E.S.A. bars have been adopted this bar has been retained for works use as it represents various jobs better than either the 1.2-in. or 2.2-in. dia. bars."

Experience has shown that the 1⅝-in. dia. pattern gives a bar 1.6 in. to 1.7 in. dia., and breaking loads are within practical limits of those from 2-in. by 1-in. bars, the usual increase in transverse strength of a round bar over a rectangular bar being offset by the thicker section. Tensile strengths are also practically the same.

Further advantages of this bar are that the relation of diameter to span is practically the same as the ⅞-in. and 1.2-in. bars, and that a 1.13-in. dia. (1 sq. in. area) tensile test-piece is 47 per cent. of the original bar compared with 42, 44 and 66 per cent. of the ⅞-in., 1.2-in. and 2.2-in. bars respectively.

The wide difference in the proportion removed in machining the tensile bar from 2.2 in. compared with the ⅞-in. and 1.2-in. bar appears to have a marked effect which is best illustrated by some calculations made on the results given by the I.B.F. Sub-Committee (Foundry Trade Journal, July 12, 1934), shown in Table I.

The ratios of transverse to tensile confirms that with increasing strength, tensile rises faster than transverse, but a point which is not so generally appreciated is the wide range of this relationship, although compared with the writer's results the 1.2-in. ratios are all high.

Table I.—*Table showing Ratio of Transverse to Tensile Strength of Cast Irons from I.B.F. Sub-Committee Graphs.* (Foundry Trade Journal, July 12, 1934.)

Tensile. Tons/sq. in.	⅞ in. dia.			1.2 in. dia.			2.2 in. dia.		
	Mean.	High.	Low.	Mean.	High.	Low.	Mean.	High.	Low.
7–8 ..	—	—	—	—	—	—	2.51	2.84	2.18
8–9 ..	—	—	—	2.95	2.97	2.94	—	—	—
9–10 ..	—	—	—	2.50	2.60	2.42	—	—	—
10–11 ..	—	—	—	—	—	—	—	—	—
11–12 ..	—	—	—	2.40	2.41	2.40	1.92	1.95	1.88
12–13 ..	1.70	1.91	1.53	2.53	2.65	2.42	2.19	2.32	1.97
13–14 ..	1.78	1.82	1.74	2.52	2.67	2.35	1.89	2.08	1.71
14–15 ..	1.83	1.94	1.66	2.33	2.48	2.18	1.92	2.22	1.72
15–16 ..	1.73	2.02	1.63	2.12	2.38	1.87	1.90	2.01	1.78
16–17 ..	1.72	1.82	1.53	1.88	2.00	1.67	1.87	2.10	1.67
17–18 ..	1.46	1.53	1.24	2.07	2.22	1.99	1.96	2.22	1.75
18–19 ..	1.57	1.60	1.53	2.00	—	—	1.78	1.77	1.79
19–20 ..	1.50	1.67	1.40	1.90	—	—	—	—	—
20–21 ..	1.43	1.47	1.40	—	—	—	—	—	—
21–22 ..	1.47	1.53	1.41	—	—	—	—	—	—

The lowest ratio for any tensile strength occurs throughout with the small bar, but the highest ratio which might be expected to apply to the large bar (on the principle that a factor which lowers transverse will lower tensile to a greater degree) does not apply, as the ratio for the 2.2-in. bar is between the ⅞-in. and 1.2-in. bars, both in the table and when calculated for each series separately. The shorter span in relation to diameter of the 2.2-in. dia. bar should favour it in transverse, thus raising the ratio, but the reason for this bar being apparently stronger in tension is most likely due to the greater proportion of the original bar in the machined tensile test-piece.

Table II gives the dimensions and relative sizes of the three standard bars together with the extra bar used in these works, showing the close relationship of the latter to the ⅞-in. and 1.2-in. bars.

Table II.—*Relative Sizes, etc., of Three Standard Test-Bars and the Extra "W-S" Bar.*

Bar.	Transverse.			Tensile.		
	Dia.	Span.	Span. / Dia.	Dia.	Area.	Proportion of original bar.
	In.	In.		In.		
S ..	0.875	12	13.7	0.564	0.25	41.7
M ..	1.2	18	15.0	0.798	0.50	44.4
"W-S"	1.655	24	14.5	1.13	1.0	46.7
L ..	2.2	18	8.2	1.785	2.5	66.0

In conclusion, it is the writer's opinion that the adoption of the 1⅝-in. dia. by 24-in. span bar as standard would not only give breaking loads familiar to the foundryman, but would cover a vacant range in the present specification, and give results comparable with those obtained from the ⅞-in. and 1.2-in. dia. bars.—Yours, etc.,

G. L. Harbach, Metallurgist,
Worthington-Simpson, Limited.

Newark-on-Trent.
September 25, 1934.

Alloys of Iron Research

(Concluded from previous page.)

a series of Papers from 1924 onwards which are for accuracy and value unequalled by any laboratory in the world. Regarding the effects of impurities, it may be mentioned that chromium itself is a soft metal, its ordinary commercial hardness being due to 4 per cent. of nitrogen. Oxygen in otherwise pure iron is a relatively harmless impurity. Pure manganese is brittle and hard enough to scratch glass, and so on. Foundry metallurgists have great interest in work of this kind which makes the tools of their trade more accurate, and also because it is understood that the iron-carbon system is the next to be redetermined.

Random Shots

"Marksman" is not old enough to give a learned dissertation on the vital statistics of technical societies, but for those catering for the metal industries he can vouch for the fact that the Institute of British Foundrymen, the Institute of Metals, and the British Cast Iron Research Association were born in Birmingham. As all these bodies are prospering, it seems to augur well for that lusty young infant, The Institute of Vitreous Enamellers, which was born there last week-end.

* * *

Some of this youngster's godfathers and godmothers quickly got into mischief. They raided the bedroom of a prominent member, tied his pyjamas in knots, placed many things between the sheets, not habitually found there, and generally made a nuisance of themselves. Alas! everything being so festive, one could not expect them to read numbers correctly at two o'clock in the morning, and it was only next morning that it was found that a mistake had been made, and now it only remains for "Marksman" to apologise to the victim, who may or may not be a vitreous enameller.

* * *

Omitting dappled-grey, the vitreous enamellers have some close connection with art and colour, and "Marksman" warns those who propose participating in the second annual conference of The Institute that they must interest themselves in dressmaking, as we have seldom seen in the provinces more brilliant examples of this branch of creative art. "Marksman," having no "ticket" as a member of "the national union of fashion correspondents," is unable to indulge in this branch of literature, but on the next occasion he intends to enlist the aid of "Chrissy," as he is certain that her versatility embraces things other than secretarial work and mountaineering

* * *

"Marksman" has just been rudely interrupted by four of his colleagues to participate in an experiment in mechanico-metaphysics. After parking him in the editor's chair, four of his colleagues made an abortive attempt to lift him by tucking eight ink-stained fingers under his arms and knees. They failed. Then eight paws were placed one after the other on "Marksman's" curly locks. They were solemnly withdrawn, mitt by mitt, after which a second attempt was made at lifting, but this time such success was achieved that "Marksman's" head narrowly missed contact with the ceiling. Engines were reversed and "Marksman" took his corner in the dynamic part of the experiment, and after failing to raise the heaviest man on the staff, before the pate-handling part of the process, found his efforts crowned with success immediately thereafter.

* * *

If only the B.C.I.R.A. could get down to the fundamentals of this unquestionably interesting experiment and applied the theory to moulding boxes, we could look forward to a really interesting Paper on the elimination of cranes in foundry practice.

"Marksman."

New plant has just been brought into operation at the works of the Slag Reduction Company, Templeborough, Rotherham, for the bitumenisation and tarring of steelworks slag for road-making. It includes a screening and grading section, with a capacity of 40 to 50 tons per hour. New plant was necessary owing to the big increase in the production of slag at the steel furnaces of Messrs. Steel, Peech & Tozer, the entire output being taken under agreement by the Slag Reduction Company. Plans for the new and extended plant were drawn up after consideration of exhaustive tests made at the National Physical Laboratory.

The Institute of Vitreous Enamellers

FIRST ANNUAL CONFERENCE AT BIRMINGHAM

The first annual conference of The Institute of Vitreous Enamellers, Limited, was held in Birmingham during the week-end beginning on September 28. It was fitting, as well as convenient, that Birmingham should be chosen, because it was there that The Institute was founded, and where the preliminary meeting took place. This first gathering was held at the British Industries Fair (Birmingham Section) on February 28 of the present year, when a Founding Committee was appointed. For the purposes of historical record it may be mentioned that Mr. J. T. Gray (Jas. Gray & Sons, London) organised this preliminary meeting, which aimed at setting up an organisation for the industry, and that Mr. W. H. Whittle, of Eccles, Manchester, was appointed chairman of the Committee. Exactly a month later, on March 28, at the Birmingham Chamber of Commerce, the formation of the proposed Institute was ratified and officers were elected. A draft constitution was submitted at this second meeting, in which the objects of the Institute were set forth, and this was in its general outline approved. The Institute Council was also elected, and by unanimous consent it was decided to ask Dr. J. W. Mellor, F.R.S. (hon. general secretary of the Ceramic Society), to accept the position of Foundation President. Happily, Dr. Mellor agreed to take office.

The Banquet Celebration

The conference was preceded by a banquet at the Grand Hotel on Friday evening (September 28). There was first of all a reception by the President and the Deputy Mayor of Birmingham (Alderman J. B. Burman, J.P.), who came in the unavoidable absence of the Lord Mayor, and thus gave civic recognition to the new Institute. Alderman Burman is a former Lord Mayor and in recent years represented the Duddeston Division of Birmingham in Parliament. After the banquet there was dancing, and during an interval additional interest was lent to the occasion by an exhibition of ballroom dancing by the Midland professional champions and world finalists. The company was thoroughly representative of the industry, leading members both on the manufacturing and supply sides being present in strong force, while at the head table the President was supported by prominent men in the political, civic, industrial and scientific world.

Following the loyal toast, Col. J. Baldwin Webb, D.L., M.P., proposed the toast of "The City of Birmingham." He said the city appreciated very highly the honour which The Institute had bestowed upon it by selecting Birmingham for its conference. Birmingham was a fortunate city in that it possessed well over a thousand industries, and he could not forget what his friend and colleague, Mr. Amery (who was with them that evening), had done for Birmingham and for the Empire in promoting trade, goodwill and unity. Their hope and belief was that the industries of Birmingham would regain their former prosperity—some were already prospering—and that this progress would be part of a general advance in industry and commerce in the country.

Humour and Praise

The Deputy Mayor, in response, said it was very gratifying to know that their Institute was founded in Birmingham, and its promoters were to be congratulated on having succeeded in establishing it so well. He must tell them, however, that it was but a short while ago that he was made aware that he would be representing the Lord Mayor at that function; but he might be permitted to say on behalf of the city that they regarded the choice of Birmingham for their first banquet as a great compliment, and, judging by the large company before him, he thought he could assume that it promised a successful beginning for their organisation. When he noticed the name of their Institute, he decided that it was necessary for him to "read himself into the proper atmosphere," because their organisation came to him as something quite new, and required looking into if he was to appreciate what it portended. So he took down the family dictionary, and thought that he should do no harm perhaps if he first turned to the term "vitreous." Now he gathered from their President that there was some little dispute as to the exact meaning of the word "vitreous," and he understood Dr. Mellor also to say that he himself was unable properly to define it; hence he should leave that matter to the dictionary definition and to their own particular preference. Then he looked at "enamel," and passed on to "porcelain," but he must confess to feeling a little nervous as to what the difference between enamel and porcelain really was. Next he alighted on the still more difficult term "ceramic"—which Alderman Burman deliberately pronounced "keramic," amid further amusement. Those in the industry desired to ensure that the products of their industry should be genuinely manufactured vitreous porcelain enamel, and they did not like the phrase synthetic vitreous enamel. As one not connected with the vitreous enamel or porcelain industry, he could, after reading something about it, appreciate how important it was. He gathered that it had been a rapidly-developing industry, and played an essential part in the ever-widening circle of interests associated with various other industries.

Civic Approval

It was quite certain to him, judging by that very large and influential assembly, that it was high time that they had united themselves in an Institute of that kind. He considered that they were most fortunate in their President, and he believed they were also most fortunate in their other officers. Moreover, he thought they were right in founding an Institute specially devoted to their own particular industry, rather than being content to ally themselves with the ceramic side. He thanked Col. Baldwin Webb for the agreeable words he had spoken about the city of Birmingham, and the company for the kind way in which they had received the toast.

Antiquity and Modern Progress

Col. the Right. Hon. L. S. Amery, P.C., M.P. for the Sparkbrook Division of Birmingham, proposed "The Vitreous Enamelling Industry," and first of all facetiously remarked that he rose under a certain sense of grievance, as the previous toast, although confined to the city of Birmingham, had been so enlarged upon that his own toast had been invaded. His old friend, Col. Baldwin Webb, had sung the praises of Birmingham, and one might have thought that a member of the City Council would have replied to these praises, uttered by one who had also sat on that body, in an appropriate manner by giving statistics about tramway mileage and so on. But instead of reciting those things by which the progress of Birmingham was habitually measured in civic speeches, he found that the worthy representative of the city had by some process of flux in relation to terms melted them into the subject of his special toast.

Members of The Institute of Vitreous Enamellers Photographed in the Yard of the Parkinson Stove Company, Limited, Stechford, Birmingham.

However, he must confess that he had taken advantage, just as the Deputy Mayor had done, of consulting a dictionary, only he himself looked up the Encyclopædia Britannica. He could assure them that in so doing he spent a most interesting time, and learned a great deal about certain historical characters and about enamel-ware among the ancients. He also gathered from that Encyclopædia that the enameller's art was one of the most ancient and honourable in history, and that its origin seemed to have been lost in the dark mists of antiquity. He had tried to find out from their President where enamelling really began, but he firmly declined to say whether it was in Egypt, Babylonia or China. Instead, he stated that it began with the ladies; among the fair sex whose love of ornamentation compelled mere man to interest himself in the provision of ornaments.

Be that as it might, there was no doubt that enamelling, whether on metal or on some form of earthenware, went back to the remotest antiquity. Mr. Amery cited the beautiful specimens still in existence—tokens and many other objects—of ancient Egypt and Babylonia, of China and of early Celtic origin; and proceeded to say that, although antiquity might have accomplished much, both in beauty of design and durability, there was no doubt that the art and craft and work of enamelling in all its branches had advanced enormously of recent years. To him it was of extraordinary interest to notice the increase in the variety of enamelled art, and the increasing cheapness and very moderate prices at which it was available, as well as the continued improvement in design and beauty of many of the articles now produced. Then, of course, he was aware that on the bread-and-butter side—the side connected with everyday requirements—articles such as were to be seen on public omnibuses as advertisements, decorative signs, and the wide range of ordinary domestic fittings and utensils—how this, too, had increased and how their quality had throughout kept level with the general progress of their art. He was particularly glad to think that it was on English soil that this art had flourished, and enjoyed to-day the advantage of national protection in actual operation. Whether that protection was adequate or not, it was not for him to say; it was a matter on which, if any of them had any doubts, he would refer them to the Import Duties Advisory Committee, who would give their case the most sympathetic and careful consideration in the interests of the manufacturer as well as of the consumer; he supposed there were "consumers" of enamel. No doubt, from a technical point of view, their craft and industry was progressing, and had reached a stage when its members should work together in unity, and combine for their common interests. It was a wise step to associate themselves in an Institute by which they could defend these interests both at home and in the world outside; by which they could exchange information, pool their researches, and pool their improvements in technical processes. He thought that nothing was more remarkable in the life of the country than the change which had come about in this respect. The old individual and selfish view, by which each factory thought its one chance of success lay in keeping its methods to itself and doing down its neighbour, had been replaced by a national sense of the corporate and common interests of our great industries; and that, in the long run, an industry and all its members flourished more by working together, by helping each other, by fighting their battles in common with the outside world, than by adopting a policy of narrow selfishness. The growth of corporate organisations, and still more of the corporate spirit, in British industry had been one of the most remarkable features of the last few years, and he believed it was going to mean a great deal for British industry in the future. British industry was by no means dead; it was still filled with life and vigour and enterprise, and fully capable of holding its own in the world. In this new effort to organise their own great industry for pressing home its self-advancement and technical improvement, they had taken an interesting and valuable step. And in associating their President with the toast, he might say that Dr. Mellor brought to their branch of enamelling a great fund of scientific and expert knowledge, derived from his experience in that other great branch of the enamelling industry—the ceramic; and they were particularly fortunate in securing a scientist with so wide an experience to be their President.

The President on Mutual Aid

The President, in response, thanked Mr. Amery for the agreeable things he had said about The Institute and the industry in so pleasant a way, and humorously remarked that he was sorry the proposer of the toast had a grievance against his friend on the right, because he himself had a grievance against his friend on the left, inasmuch as the subject he was intending to speak about was geographical representation. Proceeding, Dr. Mellor said it was the spirit of mutual aid which had really brought them all together. The Institute had just been born, the herald angels had sung their little bit, the christening ceremony had passed off satisfactorily, and he thought the auspices were happy and favourable, and the promoters of their organisation very thankful that their efforts had been so far successful. They now had the confident hope that the lusty child would grow and enjoy a fruitful, prosperous and glorious career. So much so that he hoped and trusted that in future years, even when they had passed away, their successors would be able to pay tribute to The Institute for the good work which would have been done for them, and be able to say that "those old boys laid the foundations truly and well." The spirit of mutual aid which had been the foundation of The Institute, was truly the same spirit which brought about the growth of the Guilds in mediæval times; and it was only when the State took over a great many of the functions of these old Guilds that numbers of them were rendered unnecessary. But that spirit still survived in the manufacturers' federations, in the trades unions, and in technical societies and institutes of that kind. He thought that one and all had fundamentally the spirit of mutual aid behind them. In fact, he considered that the motto of mutual aid might well be adopted by The Institute. Even though they might be bloodthirsty competitors in business, they would be brought closer and closer together as they realised that their objects were the same, that they were harassed by the same difficulties and were pleased by the same successes. He ventured to say that they would not lose, but rather would gain a good deal by new associations secured through the medium of The Institute, and by a new outlook on things; and, further, they would learn to doubt where before they had dogmatised, and to tolerate where they had formerly execrated. In this connection he might say that he was so impressed by the fact that he was sitting between two literary gentlemen that he could have wished they had brought with them their family Bible, so that he could have read a particular chapter. However, he did appreciate the encomiums which they had passed, and which he hoped would deservedly apply to their Society after it had experienced a few years of growth, because at present they were only in the baby stage.

Chairman on Technique and Sales

Mr. W. H. Whittle (Chairman of the Council), in submitting the toast of "The Guests," said the Council was extremely gratified to see such a large response to their first attempt in social functions. He proceeded to name several prominent guests, among them the principal speakers, and also referred to Mr. R. J. Rogers (Parkinson Stove Company), the President of the Institute of British Foundrymen (Mr. Roy Stubbs) and Mr. J. A. Lacey (President, Institute of Cost and Works Accounts), together with Mr. Barrington Hooper, C.B.E., who was managing director of Industrial Newspapers, Limited, and was therefore intimately associated with The Foundry Trade Journal, and interested in the progress of their industry. The name of Stubbs was an honoured one in this country and throughout the world, and was known to them because the enamelling industry and the foundry trade were closely allied. It was Mr. Roy Stubbs' uncle, Mr. Oliver Stubbs, twice President of the Institute of British Foundrymen, who established the medal bearing his name, and it was of interest to state that two of their Vice-Presidents, Mr. V. C. Faulkner and Mr. J. W. Gardom, were possessors of that medal. He mentioned this fact just to show that on the Council they had some of these highly-technical representatives referred to in a general way by one or two of the speakers; and, of course, Mr. Faulkner was well known to them as editor of The Foundry Trade Journal. Mr. Amery, they would recall, was Colonial and Dominions Secretary in a former Government. Some people said, although he did not know whether they would all agree with this, that he was some years ahead of his time; but he was sure that they would agree that he was always willing to help their industry, particularly where tariffs were concerned. On behalf of The Institute, he gave their guests a most hearty welcome, and assured them that the Council appreciated the assistance which they had lent by their presence. In carrying out the objects of The Institute, a great amount of sectional work was needed, and they were not unmindful of the importance of social functions in bringing the various sections together. Therefore, it was fitting that, as spokesman for the Council, he should acknowledge the organising work of the Sub-Committee—Mr. Gardom, Mr. W. S. Grainger and Mr. W. Todd, their vice-chairman and the Conference secretary—who had arranged that function and carried it out so well. Their national meetings, which were to be held in London, Birmingham and Manchester, occupied a good deal of time, and the presence of that large company gave them an assurance that they should go ahead with every prospect of success. They were particularly glad to welcome so many ladies, all the more so as in their industry the ladies formed a large proportion of their customers, while mere man worked and earned the money so spent. The Institute was in the main a technical body, but at the same time it was concerned with the economic aspect and with the manufacture of commercial articles which were, he submitted, well worthy of their consideration.

Mr. Barrington Hooper, C.B.E., who responded, heartily congratulated all those responsible for that function and for the actual creation of The Institute. He could assure the Council that the guests appreciated very highly the efforts which had been made for their comfort and the generous hospitality extended to them. Perhaps he might add a compliment to one whom he might describe as the parent of The Institute—he only knew of one, and that was Mr. Gray—believing that a reference to him would not be out of place. They as visitors recognised the value of the "get-together movement," which had resulted in the birth of that Institute. It was very definitely an age of "getting together." He himself was pleased that members of the vitreous enamelling industry had at last combined; it was an inevitable step if their industry was to progress to the full. He had listened with great interest to the speech of that fearless and thoughtful political leader, Mr. Amery, who had been telling them of the antiquity of the vitreous enameller's craft, and one wondered how old their great industry really was. As guests they admired the work which

(*Concluded on page* 214)

Vitreous Enamelling on Cast Iron and Sheet Steel*

By A. England, M.Sc. (Consulting and Analytical Chemist)

Early History

The early history of any people, as is well known, is not easy to trace. Looking back along a vista of years to one's schooldays, of history one remembers only Kings and Queens, and even among those, perhaps only one or two associated with various facts which serve no useful purpose are recalled.

One remembers William, Duke of Normandy, who won the battle of Hastings, but forgets that he was responsible for that wonderful record, the Domesday Book. Henry VIII is remembered as the " professional widower " and Queen Elizabeth because Walter Raleigh once laid down his cloak so that she should not soil her dainty feet.

How many can go back in family history for more than a few generations? Perhaps it is just as well, as possibly we might not be too proud of some of those hard drinking, hard riding, cockfighting ancestors.

The author possesses an Airedale dog, and although the breed was unknown fifty years ago, no one is able to trace its development. If such be the case with something comparatively modern, how is one to trace the development of various processes which have been practised in many countries over periods of thousands of years?

The arts of making glass, pottery and enamels come hand in hand down the ages. Most probably, the first vitrified substance produced artificially was glass, whether, as legend has it, by the accidental fusing of sand with alkali in the desert, or as is more probable, in the fluxing of precious metals, will never be known.

The art of making glass vessels originated in China and Egypt, and had for a long time its chief centre in Thebes. From there it spread to Phœnicia and other Eastern nations. Pliny is the first to give an account of the preparation of glass by fusing sand and soda together. The colouring of this glass was probably more or less accidental in the first place, and then naturally the workers would try any coloured mineral that was to hand. The development of a coating of this glass on a metal article was probably due to the observation that when it was being worked a coating was formed on the end of the blowpipe. This can be seen to-day by anyone visiting a glassworks.

" Hast thou with him spread out the sky, *which is* strong, *and* as a molten looking glass? "

This quotation is from Job, Chap. 37, v. 18.

" And I looked, and, behold, a whirlwind came out of the north, a great cloud and a fire infolding itself, and a brightness *was* about it, and out of the midst thereof as the colour of amber, out of the midst of the fire."

Thus says Ezekiel, Chap. I, v. 4.

What are we to make of this word " Amber "? Does it mean glass or enamel?

Undoubtedly the art of enamelling down to the end of the eighteenth century was concerned with the decoration of metals, and there is no account of its having been put to a utilitarian purpose. Some branches of this art of enamelling were probably carried out in India and Persia prior to its use in China. It is beyond the scope of this lecture to deal with the various methods of decorative enamelling such as Champleve, Cloisonné, Plique à jour, etc. Specimens of these can be seen in the British Museum. Regarding the development of the art in England, the author acknowledges with sincere gratitude that he has received much information from his friend Mr. H. B. Steward, enamel chemist at the Cannon Iron Foundries, Limited, Deepfields.

At Polden Hill and Norton, in Suffolk, Champleve and bronze ornaments have been discovered; these are coloured yellow and red, and belong to the first or second century of the present era. Moreover, his friend Mr. Jackson, who has supervised the excavations at Uriconium, has shown the author various specimens of glass and enamels, and he would advise anyone who is interested in the Roman occupation of this country to spend a day with Mr. Jackson there.

Mr. Steward says that in searching for other records of early enamelling, he finds nothing further until the time of Alfred the Great. In the Ashmolean Museum at Oxford there is a gold jewel which was found in 1696 near the abbey at Athelney (generally remembered as the place where, according to legend, the king burnt the cakes). It bears an inscription which reads: " Alfred me had made." It is red, green and blue.

After this period there seems to be a blank in records of enamels in this country until the middle of the eighteenth century, when, at Battersea and Bilston, articles wrought in copper were being made and decorated with enamels. These goods were such as were in vogue with our ancestors and consisted of candlesticks, dress ornaments, snuff- and tobacco-boxes and suchlike.

This review has rapidly scanned the centuries until now it arrives at the age of the scientific revolution, the era of Lavoisier, Dalton, Priestley and Cavendish. It would be daring to state that these men directly influenced vitreous enamelling, but they were the stars in the firmament of scientific progress, and they serve to show the development and trend of scientific thought of the time.

Vitreous Enamelling on Cast Iron

Vitreous enamelling on cast iron is most probably of French or German origin dating about the end of the eighteenth century. In Britain, a Dr. Sandy Hickling was granted a patent on February 28, 1799, for a method or methods of improving and beautifying certain vessels used for chemical, culinary and other purposes. At Wednesbury he started a factory which unfortunately was not a success. Cast-iron pots were also made under this patent at the Eagle foundry in Birmingham. About the year 1830 the firm of Messrs. T. F. Griffiths & Company, of Birmingham, worked a process, patented by Charles Henry Paris, for the production of hand-made and stamped hollow-ware, and soon after this for the production of enamelled advertisement plates; this latter branch being carried on in a separate factory which afterwards became the Patent Enamel Company, which factory, as is well known, is still in existence as a branch of Associated Enamellers, Limited.

Early Production of Hollow-ware

The first production of enamelled cast-iron hollow-ware on a commercial scale (after Hickling's attempt) is due to the late Mr. T. Clark, of the firm of Messrs. T. & C. Clark, of Wolverhampton. He engaged the services of Mr. T. Nachin, of the Potteries. This firm is still producing enamelled goods, and concentrates on acid-resisting products. Soon after this Messrs. Archibald Kenrick, of West Bromwich, began to produce cast-iron hollow-ware, and still do so. They also own the Anglo at Stourport, which is one of the pioneers of sheet-metal enamelled goods for household purposes. Clarks and Kenricks had a monopoly of cast-iron enamelling for over forty years.

About the middle of last century improvements were initiated by Messrs. F. Walton & Company, Wolverhampton, for stamping wrought-iron hollow-ware for enamelling. Shortly after this period other now well-known firms commenced the production of sheet-steel hollow-ware. Among these firms were Messrs. Perry & Company, Orme, Evans & Company, Chromographic Enamel Company, and the Falkirk Iron Company.

Origin of Sanitary Ware

Apparently the first firm to introduce white enamelled sanitary ware free from injurious matter was the Cannon Ironfounders. It is thought this was about 1887. The white-porcelain effect at this period was a new feature to the trade. Up to this time enamels for cast iron had been of a greenish tint. The person responsible for this new enamel was the late Mr. J. A. Steward, father of Mr. H. B. Steward who has previously been mentioned. The latitude of the enamel was found to be much greater than hitherto, and to be applicable to many different shapes of castings. It is claimed that the first roll-edge cast-iron bath was produced at the Cannon and was finished with this new enamel.

The Rule-of-Thumb Era

Though now having arrived at our own time, it is still with difficulty that one gets a clear perspective of the process. It would appear that some of the older enamellers based their formulæ on the composition of flint glass as made at Stourbridge. In order to understand this, it is necessary to know that flint glass is made from three of Fontainebleau sand, two of red lead and one of carbonate of potash, a small quantity of nitrate of potash being added for oxidising purposes. An old formula which the author unearthed has the composition, two of silica, six of red lead, and two of borax, this latter apparently having been introduced in order to lower the melting point of the mixture. This mixture was fritted and the frit then ground to powder to make it ready for use. The cleaned article (in this case cast iron) was then smeared with a viscous solution of silicate of soda and heated in the muffle. The correct temperature having been reached, the article was withdrawn and the powdered enamel dusted on, the heat from the iron causing the enamel to flow and also to adhere. The author has recently had the pleasure of seeing one of these old plants, and the best comparison he can make is, that alongside a modern plant it is like a car of 1900 beside one of 1934.

It was the day of so-called secret recipes and methods, and it is fairly certain that, thirty years ago, it would have been easier to have had access to a Buddhist temple than to have a glimpse of this plant.

The author has tried, in vain, to find some definite history of the growth of sheet-iron hollow-ware enamelling in the Black Country, but really, all that can be said about it is that, like a celebrated little darkie, " it growed." The man who had a great influence on systematic enamelling, however, was a Mr. La Barre, a Belgian, who came over to this country about forty years ago.

Modern Enamelling

So much for what one can trace of the history of this subject, and it seems profitable to deal with it as practised at present. Modern enamelling is divided into the wet and dry processes, although enamels in use for each process are basically the same; in fact, in many cases they may be interchanged. As has been already indicated, most enamel formulæ, up to recent years, have been evolved by the good old method

* Paper presented at the First Annual Conference in Birmingham of The Institute of Vitreous Enamellers.

XUM

of trial and error. Some wonderful prescriptions have been produced, and all that can be said about them is that they work—sometimes. In some formulæ, Nature has been ransacked for minerals, and the chemical manufacturer has produced everything possible. Here is an instance of an actual working formulæ:—

Borax, 20; felspar, 12; quartz, 6; flint, 12; *flourspar*, 2.5; soda ash, 5; boracic acid, 11; saltpetre, 5; zinc oxide, 13; cryolite, 2; barium, 3; and antimony, 2.5 parts. The author has corrected the spelling of all these substances except one, and the user is left to assume that the last two substances are not in their elemental form.

A modern Torquemada could not have set a bigger puzzle for a scientist. Unfortunately, in the enamel trade, there are still left a large number of people who think we yet live in the days of the alchemist, and that they are gullible, is evidenced by the fact that they are willing to buy "secret recipes" which will produce most wonderful results. Included in these recipes are most marvellous one-coat enamels, and that will-o'-the-wisp—tin-oxide substitute.

Present State of Knowledge Regarding Enamels

This is, so far as is known, based on the empyric methods of our forefathers. Modern workers have commenced with their recipes and by variation and consideration of scientific principles they have produced the modern enamel. Notwithstanding all their progress, they are still unable to make a definite chemical compound, or mixtures of definite chemical compounds in the production of enamels. As an illustration the formula of a white enamel as published by the American Bureau of Standards might usefully be investigated. It contains: Borax, 28; felspar, 25; quartz, 19; soda ash, 3.5; fluorspar, 5; cryolite, 12, and antimony oxide, 4 parts. We need not trouble about the mill additions as they are merely neutral when fused on the ware. In the melter there would be a combination of the soda and lime with the antimony oxide to form metantimoniates, and with the quartz to form silicates, which in this case, assuming that the antimony had first choice, would be trisilicates. What happens to the borax, felspar and cryolite? It appears that a matrix has been made up of borax, trisilicate of soda and cryolite in which felspar and metantimoniate of soda are held in suspension. Before definite progress can be made, particularly on the lines of acid-resisting enamels, this method of construction of the enamel will have to be altered. It is suggested that what is required is a definite eutectic of insoluble compounds.

Four Essentials

However, as the above formula is typical of the state of present knowledge, one must examine what essentials are to be considered in its formation. These essentials are:—(1) The melting temperature of the finished enamel; (2) the expansion of the enamel in relation to that of the metal on which it has to be applied; (3) the elasticity of the enamel, and (4) the durability of the enamel, which is closely related to its solubility in water, in acids, and in alkali solutions.

At the beginning of the present century, Dr. Hovestadt published a work dealing with the physical attributes of Jena glass and probably that is still standard. Further work has naturally been carried out, but so far as is personally known, only to amplify the conclusions as detailed by Hovestadt. These conclusions regarding glass can be applied to vitreous enamels.

(1) The melting temperature of an enamel, and by that is meant the temperature at which it is fired on the ware (and there is a best temperature for every enamel), is largely a matter of trial. The melting temperatures of most enamels are between 700 and 900 deg. C. It has to be remembered that if one seeks to soften or harden an enamel there are other factors to be taken into account; expansion, elasticity and solubility. It is therefore not just a matter of adding another bucket of borax or soda ash to the melt, for in that case errors are creeping in elsewhere. In the aforementioned formula the melting temperature could be varied, on the soft side by alteration of the borax, soda ash or fluorspar; on the hard side by addition of more felspar or quartz. It is in these alterations that one encounters the greatest difficulty, *i.e.*, the alteration of the expansion of the enamel. All good modern enamels are built up with the object of having the same expansion as the steel or iron. The coefficient of cubical expansion of steel is 0.000033, and it has been found that a slightly less expansion of the enamel is most suitable; that is, the enamel must be in a slight state of compression.

Work of Expansion

The pioneers of the work on expansion of the various constituent oxides forming glass and enamel were: (1) Winkelmann and Schott and (2) Mayer and Havas. These men worked out the expansion ratios for these oxide constituents, and with slight modifications these can be taken as standard to-day. The variation of the expansion coefficients is very large, if one expresses B_2O_3 as unity, Na_2O is 100. The formula of a clear cover enamel with its composition and expansion ratios thus regarded becomes interesting. This is, of course, the fritted enamel as it comes from the melter.

	Percentage.	Expansion Coefficient.	Total Expansion.
Na_2O ..	12.7	10.0	127.0
B_2O_3 ..	16.9	0.1	1.7
K_2O ..	6.0	8.5	51.0
Al_2O_3 ..	10.0	5.0	50.0
SiO_2 ..	45.0	0.8	36.0
Cryolite ..	9.2	7.4	68.0
		Total ..	333.7

It can be readily understood that to keep this total figure round about 333 and vary the constituents in order to soften or harden becomes a mathematical problem.

Elasticity

Winkelmann and Schott have also published figures dealing with the modulus of elasticity of glasses on the same lines as for expansion. The following figures give Young's modulus for the different oxides. Young's modulus is "The force required to stretch a substance of unit length and unit cross-section to two units of length."

In this case—

Kilograms per square centimetre

SiO_2 ..	65	B_2O_3 ..	20	ZnO ..	15	PbO ..	47
MgO ..	600	Al_2O_3 ..	160	As_2O_3 ..	40	BaO ..	100
Na_2O ..	100	K_2O ..	71	CaO ..	100	P_2O_5 ..	38

It follows, therefore, that the lower one can get this modulus of elasticity, the more easily is the enamel stretched. It will be observed that the two oxides, boric and zinc, have the lowest modulus, and therefore will tend to give any enamel containing them a high elasticity. Unfortunately some makers of enamels see a statement such as this, and without further ado proceed to add zinc oxide to their enamels without due consideration of other factors.

Impact Resistance

Closely connected with the question of elasticity is the ability of enamels to withstand impact, and there is a possibility of people who do not understand enamels trying to govern the enameller as to the properties of his products. In some cases the specifications set down are impossible of achievement, commercially. It has been shown how elasticity may be controlled, but in connection with the impact test there is to be taken into account the thickness of the enamel coating. It might be said at once that the resistance to impact is for practical purposes in inverse ratio to the thickness. For instance, a direct cast-iron enamel will stand up to blows which would instantly shatter a second or third coat on either sheet steel or cast iron. It might be laid down as an axiom that the thinner the enamel coating, other things being equal, the better.

Raw Material of the Industry

Before dealing with processes of enamelling, the raw materials which are used in the production of the frits must be considered, and here, let it be said, the author is all in favour of pure synthetic materials where they can be used; with these, it is certain that more definite results can be obtained; undoubtedly many of the troubles which enamellers have to meet are due to the variation of raw materials when in the mineral form. Concerning proprietary substances in use, *i.e.*, borax, soda ash, etc., there is nothing to be said, as they can be taken as constant. The most important natural substance entering into the composition of enamels is felspar, and although there is no wish to introduce commercial arguments into this address, in this particular case it is necessary. The enameller in Great Britain can buy felspar at prices varying from £4 to £7 per ton. It is only natural that the buyer for a large firm, having little or no technical knowledge, buys the cheapest material offered. He has effected a direct saving, and that is all that concerns him. The only real way to buy felspar is on its potash content, and one firm in this country does this, and allows the supplier a variation of 1 per cent. each way; *i.e.*, a felspar sold with a 12 per cent. potash content must yield somewhere between 11 and 13. One of the chief causes of trouble in enamelling is due to mica in cheap felspars, as it is impossible to get this into solution on the melter. The flat plates of mica can always be detected if examined by a microscope. It is, without doubt, the cause of a large amount of fish-scaling, for there are, on the finished enamellel article, small, unabsorbed particles enclosed in a matrix of enamel in which there is no correspondence of expansion ratios.

The author was asked by one of the committee of The Institute of Vitreous Enamellers to make some statement which would let loose the dogs of war in the shape of discussion, and here it is:—

All fishscaling is due to some particle of matter which is not homogeneous with the enamel in which it is embedded.

As a raw material, the next in importance is silica, whether used as sand, quartz or flint; in most cases in the enamel industry quartz is used. The author has personally analysed a large number of samples of this mineral, and in some cases the percentage of silica was as low as 94 per cent. How is it possible to obtain a constant enamel if variable raw materials are used indiscriminately?

Next there is fluorspar, but as most enamels do not contain over 5 per cent. of this, any adulteration does not matter so much. The preceding arguments apply to any mineral substance used in enamelling.

The Actual Processes of Enamelling

It is not proposed to deal with methods or problems of cleaning the ware, but to proceed with the enamelling proper. Keeping to the historical trend of this lecture, it is proposed first to deal with the cast-iron-dusting process. Nowadays, this method is mainly in use for large articles, such as baths, and without a doubt it is the method which gives the best finish to an enamel, mainly because no extraneous material is milled into the enamel; mill additions always tend to impair the finish of an enamel, and, owing to the thicker coating given by dusting, much more of a porcelain finish is obtained. It is due to this thickness of enamel that it is of the greatest importance that the coefficients of elasticity and expansion shall be correct. Undoubtedly, a lead enamel eases the

path of the bath enameller, but here it is desired to make it clear that the author is not dealing with enamels containing either lead or barium compounds.

Before going further with the subject of cast-iron enamelling, it can be said that it is essential that the enamel shop should get cast iron which *will* enamel. Unfortunately, most people seem to be of opinion that anything bearing the name of cast iron will take a coating of enamel. It is essential that the cast-iron article should be just as clean as a piece of enamelling sheet steel. By this it is not meant that the surface should be sand-blasted clean, but that the iron as it runs from the cupola should be clean. Any enameller or foundryman will understand what is meant by this. For good results the iron should not, in personal opinion, have a silicon content of over 2.5. The last point concerning the casting is that it should be, as near as possible, of uniform thickness.

The casting is now ready for the enameller, and first a grip coat is brushed or sprayed on; this may, when fired, produce either a matt grip or a vitreous. The latter is much to be preferred, as a matt grip is not actually an enamel, but merely a more or less neutral coating adhering to the pores of the iron. The author has seen several cases (both dusted and wet) where a matt coating has been used and a flaw has developed in the cover enamel; water has then found its way into the more or less soluble matt coating, with the result that the cover enamel has peeled away. In cases where it is possible for steam to come in contact with the outside edge of a casting, say an oven door, if a matt coat has been used, there is a possibility of its being dissolved with the subsequent destruction of the cover enamel.

A large casting, say a cast-iron bath, with its dried grip, is now introduced to the muffle and brought to the required temperature, say 850 to 900 deg. C. The bath is then withdrawn and placed in a cradle, which can be revolved and also tilted to any required angle. The white, or in some cases the coloured, enamel cover-coat, is then dusted on, what time the bath can be moved in any direction by an electrically-controlled motor. The sieve which is used can be vibrated either mechanically, pneumatically or electrically. Cover enamels are generally ground to pass a 60-mesh sieve, and the duster itself has a 40 mesh. The final result depends to a great extent on the ability of the enameller, or, as one may call him, the duster, as even the very best enamel can be spoiled by bad application. The bath having received its coating of cover coat is reintroduced to the muffle, and the enamel fired down or "flowed" as it is termed. Generally, two or more dustings will be required, and the total time taken is from twenty minutes to half-an-hour.

The author cannot help feeling that, after this enamelling, a more careful cooling down or annealing would produce a better article than is obtained by placing it direct on the floor of the muffle room. In fact, concerning all types of enamelling, the question of annealing is not considered. Time will not permit the discussion of faults, such as crazing, bubbling, blisters and such like; sufficient to say that, given a good enamel, a good, clean casting, then the finish depends on the care taken by the workmen.

A point to which attention should be drawn at this juncture, as it has an economic significance to the enameller, no matter what type of enamelling is concerned, is the density and consequent covering power of the cover coat. Whether the enameller makes or buys his enamel, he should keep a watchful eye on this. The density of cover enamels may vary from approximately 2.5 to 5.5, so that it is not possible to judge the quality of an enamel at so much per ton. The actual value can only be obtained by taking the cost of enamel coating per given area. For instance, a cast-iron bath, 5 ft. 6 in. long, would require about 28 lbs. of lead enamel, whereas the same bath would only take about 14 to 18 lbs. of a leadless enamel for the same coating.

Sheet-Steel Enamelling

This is the next in historical order, and it was on sheet steel that the process now known as the "wet process" was begun. There is not the slightest doubt that the enamelling of sheet-steel articles has made the greatest progress of any form of enamelling. From the standpoint of mechanical equipment and the production of articles suitable for enamelling, this has probably been the most progressive of the ceramic industries. When the production of the "blank" in cast iron is on a par with the production of sheet-steel blanks a great stride will have been made in cast-iron enamelling. Unfortunately the purely ceramic lines of the industry have not progressed as far as the mechanical. There has been little co-operation, and the industry has depended to a large extent on individuals who, by trial and error, have developed recipes. These men have done good work, but it is thought they have reached their limit, and further development will have to be on more scientific lines than hitherto. The author is well aware that he is treading on dangerous ground and that he may be accused of taking the bread and butter from the mouths of those who have done such great initial work for the industry.

In dealing with sheet-steel enamelling it is suggested that a great field of research is still open in connection with the cleaning of articles to be enamelled. It must be assumed that the ordinary processes of scaling, pickling and the soda bath are well known, so that the author can proceed at once with the enamelling process. The ware ready for enamelling is given a first coat or "grip." The older enamellers term it "grey."

First Coat Application

This first coat generally contains cobalt oxide, and it certainly seems rather strange that no grip is satisfactory unless it contains this oxide or some other such as nickel, although, be it said, a nickel coating does not give the adherence of cobalt.

The following is a typical example of an American ground coat for sheet steel:—

Borax, 30; felspar, 27; quartz, 20.5; soda ash, 10; nitrate of soda, 5; fluorspar, 6; cobalt oxide, 0.5; and manganese oxide, 1.2 parts.

This, after being melted, is ground in a ball mill with the addition of about 5 per cent. special clay, which, being colloidal, holds the powdered enamel in suspension, and approximately 40 per cent. of water, until it will pass a sieve of about 60 meshes to the inch. Some people prefer a finer grinding, and here again there is room for considerable research. On all kinds of wet-process enamels the industry requires more knowledge on "suspension," and definite work on grain-size would be useful. The correct melting of the enamel batch is extremely important, and one that is not generally realised, the supervision more often than not being left in the hands of a labourer.

The article is coated with the ground slush, either by spraying or dipping, allowed to dry at a temperature of about 130 deg. Fah. (55 deg. C.), then fired in the muffle. Quick drying of the grip is essential.

Need it be said to practical enamellers that the correct production of the ground coat is the most important part of the enameller's work? It might be postulated that at least 75 per cent. of the enameller's troubles is due to faulty ground coat. Need they be enumerated?

Cover Coats

The next process is the application of the cover coat or coats, for generally two coatings are necessary to produce a satisfactory finish. Here is a modern German formula. (Most of these formulæ have already been given in a previous lecture, but there seems to be no reason to alter them for the purpose of this illustration):—Borax, 27; felspar, 30; quartz, 16; cryolite, 15; $NaNO_3$, 4.5; and Na_2CO_3, 7.5 parts. This is melted as before, except that it should be at a lower temperature, and the frit ground with the addition of from 5 to 10 per cent. of tin oxide and sufficient clay to hold the enamel in suspension, generally 5 per cent. if for swilling, less if for spraying; the process of application, drying and fusing being the same as for the ground coat. It is necessary that each succeeding coat of enamel should have a diminishing melting temperature, *i.e.*, if the ground coat has a firing temperature of 850 deg. C., the first coat, white, should be at least 50 deg. lower, and for the best results, though not often carried out in practice, the second coat, white, again lower.

Relating to white enamels is the question of opacifiers; first and foremost is tin oxide and, second, metantimoniate of soda or potash. Personal experience with substitutes may not have been happy, and the author has no use for them. They may take the place of the above materials partially, but that is all. He is aware that a quantity of work has been done with titanium and zirconium compounds, but they have not the opacifying power of tin oxide. A good maxim is, "have nothing to do with substitutes unless the composition is given." One substitute which the author analysed a few years ago was made up as follows:—Tin oxide, 50; flint, 20; zinc oxide, 10; burnt clay, 10; antimony oxide (free), 10 per cent. One ought, in fairness, to say that it was not manufactured in the British Isles.

The subject of antimony oxide is, as is well known, a vexed one, due to the toxic properties of most of the compounds of this element. To say the least, it is most dangerous to use, unless properly controlled. If the antimony compound be added as the metantimoniate, $R_2O.Sb_2O_5$, at the mill, or, if the antimony oxide be melted in with the batch so that the metantimoniate is properly formed, there is no danger. However, it is as well not to use antimony enamels for culinary ware; this remark must also include imported ware, or the English manufacturer will be at a disadvantage

Coloured Enamels

Remarks on these will apply to all types of enamel, whether for sheet or cast iron. Coloured enamels may be divided into two sections:—(1) Those in which the enamel is coloured by melting simple metallic oxides with the batch. For instance, blues may be obtained by the addition of cobalt oxide or a mixture of cobalt and manganese oxides to the batch, the intensity and depth of the colour depending on the amount of oxide added; in the case of blues, this may vary from 1 to 8 per cent. Black frits are produced by the addition of oxides of cobalt, chrome, iron, manganese, and in some cases copper. In the case of blacks, however, it is generally an advantage to make a mill addition of prepared black oxide if best results are desired. Not many other colours are produced by melting except in the case of majolicas. (2) In most instances of coloured enamels, the shade is obtained by the addition of prepared oxide. The frit used for colours is very similar in composition to that used for whites, excepting that a much smaller quantity of cryolite is used, and therefore this has to be compensated by the addition of more bases, such as soda or potash. The main point to be controlled in building up a frit for this purpose is that it shall be neutral and have no tendency to attack the prepared oxide. After fusion on the ware the colour should be simply held in suspension, just as tin oxide is in a white enamel. The amount of oxide used may vary from 1 to 5 per cent., according to the shade required. As a matter of interest, it seems worth while to indicate how these oxides are manufactured. Taking the

case of one of the most popular colours, a blue-green, or as the older enamellers knew it, a new blue, the manufacturer starts with the purest metallic oxides of cobalt, zinc, chrome and alumina, and mixes them intimately. The perfectly-mixed oxides are then placed in "saggars" or crucibles; these receptacles are then put in a furnace and undergo a continuous firing up to a temperature of, say, 1,400 deg. C. After cooling, the material is removed, crushed (for in many instances sintering has taken place), ground almost to impalpability, and then dried.

Cast Iron—Wet Process

The last section of enamelling for consideration is the baby of the industry, although it must be mentioned that wet-process enamelling on a matt ground coat has been practised in the Birmingham area for a very long time, but only so far as is known for one class of article, *i.e.*, cast-iron hollow-ware. The author has stressed in his remarks on dry dusting of castings the importance of the base or blank on which the enamel has to be fused, and there is no doubt this is even more important in the case of wet process work. It is about time that the enameller should be more considered in the patternshop and the foundry. Given a good casting, it has to be cleaned by sand or shot blast at from 60 to 80 lbs. pressure, and here again it is felt that there is a considerable field for research, for, to put it mildly, sandblasting is the enameller's bugbear. Two methods are in general practice for the application of enamels on cast iron by the wet process.

(1) A ground coat or grip is used and a cover enamel imposed upon it. The grip may be matt or vitreous, while the cover coat may be an enamel of the ordinary type, providing it is soft enough, either white or coloured. Although the author is not enamoured of matt ground coats and does not consider them as enamels, he is afraid that, up to the present time, it is the only way by which the enameller can overcome the difficulties of dirty iron. Given a nice, clean iron, the vitreous ground coat is a proper enamel and produces a really sound job.

It is a very striking point that, if a steel enameller encounters trouble, his first thought is of the steel, and its freedom from blisters and dirt. Unfortunately, in the case of cast-iron enamelling, the iron itself is generally the last point to be considered. The unfortunate jobbing enameller, particularly, is supposed to be able to cover with enamel any metal article which goes by the name of cast iron. Let it again be reiterated, start at the beginning, which is the foundry.

(2) The second method, without the use of a ground coat, is in most general use by stove enamellers. Undoubtedly, this gives the most durable finish, and if a good enamel is used, the texture and gloss leave nothing to be desired. The enamels used for this process are much the same in composition as those for sheet steel, but have, generally, a lower fusing point, the muffle temperature for their development being round about 750 deg. C. This direct coat enamel is generally coloured with a small percentage of prepared oxide and mottled with white enamel or an enamel of a contrasting colour. Who invented mottle is not known. The author has no great opinion of his artistic sense, and he is forced to the conclusion that it was done in order to hide faults in the enamel coating.

Conclusions

In the short time available, the author has tried to give an appreciation of the position of the enamelling industry as it stands to-day. What of the future? The author is very optimistic, but, like all other things, enamelling is in process of evolution. The industry cannot stand still, more and more development from the scientific side must be looked for.

Another serious question for the trade is the question of specialisation. Lord Nuffield said (recently), "we have passed the era of mass production as such, and the industries of the future must be based on specialisation." Take the case of sheet-steel hollow-ware. How many firms specialise on one or more particular products? Each firm makes practically every conceivable article which comes within the trade. In some shops there can be seen a load of kettles going into the muffle, whilst the fuser is loading hearthplates on the spare fork. Look on the shop floor, and one will see the most miscellaneous collection of household ware imaginable. It seems to be a case of the other man is always making something in which there is more profit than in their own. Need it be suggested that these people are behind the times, and that, if they would each specialise in a certain number of articles, the cost of production would be lowered and internal competition would be considerably reduced, with subsequent benefit to all concerned.

Dare one also suggest that the time is rapidly approaching when the enameller will bend all his energies to the production of enamelled articles and not try to make his works a blend of foundry, press-shop and chemical works. Dissipation of energy has been one of the flaws in all industry, and the author suggests that the time is not very far distant when enamel frits will be left to the manufacturers who can specialise in them, and give them the treatment that such a complex arrangement of chemicals deserves.

Progress must be made in the enamel industry exactly as in other industries. The industry cannot put the clock back. It is, for this correlation of the industry that The Institute of Vitreous Enamellers has been formed; the sum total of correlated knowledge at the present is very small, and it is hoped that this Institute will fill a long-felt want. In conclusion, the author suggests that the Committee should consider the publication of Proceedings which would contain definite information on enamelling problems.

Correspondence

(*Concluded from next column.*)

iron, with little addition of total strength. This increased load affects foundations, carrying capacity of vessels, etc. The fact that these particular figures were culled from THE FOUNDRY TRADE JOURNAL makes one realise that their publication and use only fouls our own nest. Personally, I am not interested, nor is the engineer, what physical tests an utterly unsuitable iron would yield when cast into thick sections. With a proper composition the 2.2-in. bar should approximate to 75 to 80 per cent. of the 1.2-in. bar when also cast from a suitable mixture, say 14 tons per sq. in. on the 2.2-in. bar against 17 or 18 tons on the 1.2-in. bar, which is quite different from the 50 per cent. difference shown in Fig. 14. If the casting varied much in section, one would not calculate a mixture for the thin section, but stiffen it up considerably and depend on the re-annealing effect of the thick section to make the thin one correct.

I regret to take up this attitude, as I have a very high appreciation for the work the Committee is doing, but the question of these low physical returns are injurious to us all.—Yours, etc.,

J. SHAW.

2, Parkstone Avenue,
Southsea.
September 25, 1934.

THE WHOLE of the electricity for power and light at the Sheffield works of Messrs. Thos. Firth & John Brown, Limited, is to be taken from the electricity grid through Sheffield Corporation power stations on and after October 9. The company will constitute the biggest customer of electricity in Sheffield. The agreement with the Sheffield Corporation carries with it the scrapping of the electricity-generating plant of the company.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Cast Iron Sub-Committee Report

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the further reply of this Sub-Committee to the discussion that took place at the Manchester Convention.

So long as their first conclusion, viz., "That they whole-heartedly approve of the principle of varying size test-bars to represent varying sections of castings," is retained, no serious objection can be raised to any minor alteration of No. 321 Specification. *Providing sufficient data be given to warrant the alteration.* It is this utter lack of data that makes their second conclusion seem arbitrary. Why, for instance, is the L-bar considered unsatisfactory? No clear-cut reasons or data are given. Have the various members of the Committee made commercially sufficient castings, where the result from the L-bar constituted the acceptance of the said castings, to allow them to form a definite conclusion? Personally, I have found the L-test very useful, and in a number of cases the 1.2-in. bar would have been white and useless. There is also no difficulty in having the L-bar tested at any of the public testing works, if the number of bars cast during the year does not warrant buying a testing machine. With regard to the length of the L-bar. It must be remembered that most of the large spending departments at that time (and, in fact, some do now) insisted that the bar be cast on. Hence the then Committee made the L-bar as short as possible consistent with a reasonable deflection. That they hit the happy medium has recently been confirmed by MacKenzie's Paper "On the Effect of Span on the Results of the Transverse Test on Cast Iron." He shows that on three different compositions of irons the modulus of elasticity $\times 10^{-6}$ was approximately the same whether the breaking centres on the 2.2-in. dia. bar were at 18-in. or 24-in. centres, viz., at 18-in. centres the result was 9.4, 7.2, 9.8 tons, while at 24-in. centres the same bars gave 9.8, 7.2, 9.9 tons. So little is gained from the deflection standpoint by adding another 6 in. to the length of the present L-bar. The present bar is quite long enough where it has to be cast on, while the cost of testing at an outside establishment is not a heavy item. It seems a pity to disturb the dimensions of a bar that has been in operation some time and around which a certain amount of data has been collected, without adequate reasons.

There are at least three questions to which the Committee might devote their time:—

(1) With increasing metallurgical control, to formulate a new "high-test" specification, somewhat on the lines of the new Admiralty specification.

(2) The clause in Specification No. 321 relating to "The average mean cross-sectional scantlings" requires more detailed drafting so as to leave no doubt as to which bar to use. Different interpretation has caused discussion as to whether M- or L-bar should be used, owing to difference in section in the same casting.

(3) With the failure of a number of castings under slight impact, when the tensile tests were good, there is a demand for a suitable impact test on cast iron. This test would also give some idea of the "damping" effect of the specimens.

With regard to casting large bars from a mixture only suitable for thin castings, I am still utterly unrepentant. I have attended meetings where similar figures showing the great drop in physical properties with increase in section. These have been used by interested parties to show what a large increase of dead load takes place with every increase of thickness, in cast

(*Concluded in previous column.*)

Sheffield University Degree Course

COURSES OF STUDY IN METALLURGY (FOUNDING)

The prospectus has been published of the degree and associateship courses in metallurgy (founding) which have been inaugurated largely at the instigation of the Institute of British Foundrymen to supply a long-felt want for a comprehensive course of instruction in foundry science.

The courses embodied in the prospectus are intended to give the student a thorough knowledge of the fundamental principles involved and of foundry technique. Practical foundry experience is an essential part of the training.

Details of three distinct courses are given, namely, an honours course of four years' duration leading to the degree of B.Met. (Founding) Honours, an ordinary degree course of three years' duration for the degree of B.Met. (Founding) for matriculated students, and an associateship course of three years' duration for non-matriculated students.

Plant and Equipment

The department is adequately equipped for instruction in practical foundry operations, and includes, amongst other plant, cupolas, melting furnaces for steel, iron and non-ferrous alloys, moulding and core-making machines, plant for the milling and drying of sands, core ovens, and many types of gas and electric furnaces for heat-treatment operations.

The equipment includes metallurgical microscopes of the latest design, together with most modern instruments for physical determinations, and many types of pyrometers.

An X-ray plant for crystallographical work has recently been installed, and there is a well-equipped machine shop.

First Year Ordinary Degree Course and First Year Associateship Course

Chemistry

Lecture hours—Mondays, Wednesdays and Fridays, 9.30 to 10.30 a.m.

Laboratory hours—Tuesdays and Fridays, 2.0 to 5.0 p.m.

Mathematics

Lecture hours—Mondays, Wednesdays and Fridays, 10.30 to 11.30 a.m.; Thursdays, 10.30 a.m. to 12.30 p.m.

Physics

Lecture hours—Mondays, Wednesdays and Fridays, 11.30 a.m. to 12.30 p.m.

Laboratory hours—Mondays and Thursdays, 2.0 to 4.30 p.m.

All students must produce evidence that they have, during the summer months, been engaged in a foundry:—(*a*) Honours students in the first, second and third years; (*b*) ordinary degree and associateship students in the first and second years.

Honours Degree Course—Second Year

Chemistry

Lecture hours—Mondays, Wednesdays and Fridays, 9.30 to 10.30 a.m.

Laboratory hours—Tuesdays, 2.0 to 5.0 p.m.; and Saturdays, 9.30 a.m. to 12.30 p.m.

Mathematics

Lecture hours—Mondays, Wednesdays, Thursdays and Fridays, 10.30 to 11.30 a.m.

Physics

Lecture hours—Mondays, Wednesdays and Fridays, 11.30 a.m. to 12.30 p.m.

Laboratory hours—Mondays, 2.0 to 5.0 p.m.; and Tuesdays, 9.30 a.m. to 12.30 p.m.

Theory of Analysis

Lecturer—E. GREGORY, M.Sc., F.I.C.
Lecture hour—Thursdays, 2.15 to 3.15 p.m.

SYLLABUS.

Theory of methods for the determination of carbon, silicon, manganese, sulphur, phosphorus, iron, chromium, tungsten, nickel, cobalt, copper, titanium, vanadium, molybdenum and arsenic in cast iron, steel and other ferrous alloys.

FACULTY OF METALLURGY

Dean of the Faculty
Professor J. H. ANDREW, D.Sc. (Manchester)

Lecturer in Ferrous Metallurgy
W. R. MADDOCKS, Ph.D. (Glasgow), B.Sc. (Wales)

Lecturer in Non-Ferrous Metallurgy
F. ORME, M.Met. (Sheffield), A.I.C.

Lecturer in Refractories
W. J. REES, M.Sc.Tech. (Sheffield), F.I.C.

Lecturers
E. GREGORY, M.Sc. (London), F.I.C.
R. T. PERCIVAL, B.Met. (Sheffield)

Assistant Lecturer
A. J. MACDOUGALL

Research Assistant
G. A. DE BELIN

Demonstrator in Non-Ferrous Metallurgy
R. IBBOTSON

General Metallurgy

Lecturers—F. ORME, M.Met., A.I.C.; A. J. MACDOUGALL.

Lecture hours—Thursdays, 11.45 a.m. to 12.45 p.m.; and Fridays, 9.15 to 10.15 a.m.

SYLLABUS.

Chemical classification and distribution of metallic ores. Preliminary treatment of ores. Equilibria and reactions in roasting, smelting and refining processes. Typical metallurgical processes.

Metallurgical Laboratory

Laboratory hours—Fridays, 2.15 to 4.45 p.m.

Metallography

Lecturer—A. J. MACDOUGALL.
Lecture and laboratory hours—Thursdays, 3.15 to 4.45 p.m.

SYLLABUS.

Principles of metallography. Thermal equilibrium diagrams of simple systems. General properties of typical alloys. Theoretical consideration and practical examination of eutectics, solid solutions, and inter-metallic compounds.

Second Year Ordinary Degree Course and Second Year Associateship Course, and Third Year Honours Degree Course

Principles of Engineering

Lecturer—PROF. F. C. LEA, D.Sc.
Lecture hour—Mondays, 9.15 to 10.15 a.m.

SYLLABUS.

Properties of steam. Steam engines. Valves and gear. Steam turbines. Indicator diagrams. Horse-power. Gas engines and oil engines. Gas producers. Efficiencies. Air compressors. Steam boilers. Condensers. Examination of models and plant in the heat-engine laboratory. Hydraulics. Flow of water. Accumulators. Hydraulic forging presses and cranes.

Foundry Metallurgy

Lecturer—To be appointed.

Lecture hours—Mondays, 10.30 to 11.30 a.m., and Wednesdays, 9.30 to 10.30 a.m.

SYLLABUS.

Melting operations and types of furnaces used in iron and steel foundries, including cupolas, converters, reverberatory furnaces, oil, gas, powdered-fuel and electric furnaces. Fuels, fluxes and slags; losses in melting and general efficiency factors. Foundry appliances and foundry lay-out. Solidification of iron and steel; crystallisation shrinkage, segregation, influence of casting temperature, etc. Moulding and moulding machines. Core sands and coremaking. Facing sands and dressings. Methods of casting; sand, chill, and centrifugal casting. Malleable castings. Fettling and dressing of castings. Heat-treatment as applied to iron and steel castings. Alloy irons and steels.

Metallography

Lecturer—E. GREGORY, M.Sc., F.I.C.

Lecture hour—Mondays, 11.30 a.m. to 12.30 p.m.

Laboratory hours—Mondays, 2.15 to 4.45 p.m.

SYLLABUS.

Thermal-equilibrium diagrams of binary and ternary alloy systems—their construction and interpretation.

Metallography of cast and malleable irons. Metallography and heat-treatment of carbon steels, brasses, bronzes, aluminium alloys, etc.

Alloy cast irons; metallography of pearlitic, martensitic and austenitic cast irons.

Alloy steels; stainless, magnet and "manganese steel" castings, etc.

Refractory Materials

Lecturer—W. J. REES, M.Sc.Tech., F.I.C.

Lecture hour—Tuesdays, 9.20 to 10.20 a.m.

SYLLABUS.

The classification of refractories. The chemical composition and physical properties of the raw materials. The manufacture, physical and chemical properties and methods of testing all types of refractories. The production of crucibles for steel and non-ferrous metal-melting. Refractories for electric furnaces and for other special purposes. The physical and chemical properties and methods of testing moulding sands. Specifications for refractories. Foundry refractories, including cupola linings.

Lectures on Fuel

Lecturer—PROF. R. V. WHEELER, D.Sc.

Lecture hour—Tuesdays, 10.30 to 11.30 a.m.

SYLLABUS.

Solid, liquid and gaseous fuels. The utilisation of fuel. Combustion. Gas-producer practice. Furnace practice.

Electro-Technics

Lecturer — N. M. BARRATT, M.Sc.Tech., A.M.I.E.E.

Lecture hour—Tuesdays, 2 to 3 p.m.

Laboratory hours—Tuesdays, 3 to 5 p.m.

SYLLABUS.

Units. Electro-magnetic principles. The magnetic circuit. Elementary principles of D.C. machines. A.C. circuits. Measuring instruments for A.C. and D.C. circuits. Elementary theory of transformers, alternators and induction motors. Magnetic properties of iron and steel. Methods of magnetic testing.

XUM

Pyrometry, Physical and Mechanical Testing

Lecturers—R. T. Percival, B.Met; A. J. MacDougall.

Lecture hour—Wednesdays, 10.30 to 11.30 a.m.

Laboratory hours—Thursdays, 9.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m. (Honours students).

Syllabus.

The measurement of temperature. Expansion, fusion, thermo-electric, electrical resistance, optical and radiation pyrometers.

Determination of critical points in carbon and alloy steels and cast irons. Dilatation curves.

The mechancial testing of materials. Tension, compression, transverse, impact, hardness, fatigue, and creep tests, with special reference to cast and heat-treated steels, cast irons and non-ferrous alloys.

Non-Ferrous Foundry Metallurgy

Lecturer—To be appointed.

Lecture hour—Wednesdays, 11.30 a.m. to 12.30 p.m.

Laboratory hours—Thursdays, 9.30 a.m. to 12.45 p.m., and 2.15 to 4.45 p.m. (Honours students).

Syllabus.

Melting operations and types of furnaces used in non-ferrous foundry practice, including the casting and heat-treatment of brasses, bronzes, copper-nickel alloys, bearing metals and light alloys.

Deoxidisers, fluxes, slags and melting losses. Crystallisation, shrinkage, segregation, influence of casting temperature, degasification, etc. Sand, chill, centrifugal and die-casting. Foundry lay-out, mechanical appliances, and general moulding practice.

Geology (including the mineralogy necessary for metallurgical students)

Lecturer—J. Shirley, M.Sc.

Fridays, 9.30 a.m. to 12.30 p.m. Lecture, 1 hour; practical, 2 hours.

Syllabus.

Elements of mineralogy and crystal systems. The use of the petrological microscope. Optical properties of crystals. Properties of common minerals. Quartz, felspars, micas, pyroxenes, amphiboles, olivine, tourmaline, garnet, sulphide minerals, iron ores, calcite, dolomite barytes, gypsum, fluorite. Composition, texture, structure, etc., of igneous, sedimentary and metamorphic rocks. Granite, syenite, diorite, gabbro, peridotite, serpentine and their hypabyssal and volcanic representations. Sandstone, quartzite, shale, fireclay; limestone, marble; slate, schist, gneiss. Weathering and reconstitution of minerals and rocks. Stratification. Conformity and unconformity. Folding and dislocation of strata. Succession of strata in Great Britain.

Engineering Drawing and Design

Hours—Saturdays, 9.15 a.m. to 12.15 p.m.

Metallurgical students are required to submit for their final examination a set of ten working drawings of sufficient merit to satisfy the examiners, the subjects to be selected from ordinary foundry or furnace practice.

At least three of the drawings must be from hand sketches made by the students from actual apparatus.

Note.—On Thursday, third-year honours students attend classes in practical pyrometry, physical testing and foundry work, whilst second-year ordinary degree and associateship students attend the following lectures and laboratory works:—

9.30 to 11.45 a.m., Analytical laboratory.

*11.45 a.m. to 12.45 p.m., General metallurgy lecture.

*2.15 to 3.15 p.m., Theory of analysis lecture.

3.15 to 4.45 p.m., Analytical laboratory.

* See honours course, second year.

In addition to the above courses of study, students attend the analytical laboratories as under:—

Tuesdays, 11.30 a.m. to 12.30 p.m.; Fridays, 2.15 to 4.45 p.m.

Third Year Ordinary Degree Course and Third Year Associateship Course, and Fourth Year Honours Degree Course

Metallurgical Laboratory

Mondays, 9.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.

Tuesdays (Honours students), 10.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.; (Other students) 9.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.

Wednesdays, 9.30 a.m. to 12.45 p.m.

Thursdays, 10.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.

Fridays (Honours students), 10.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.; (Other students) 9.30 a.m. to 12.45 p.m. and 2.15 to 4.45 p.m.

Note.—The practical work undertaken at the times specified above includes physical metallurgy, metallography and foundry work, which will include the melting of iron and steel and non-ferrous alloys by different methods, and casting under varying conditions. Heat-treatment of castings. Moulding, including sand-casting and core-making. Patternmaking. Fettling and dressing of castings and general foundry practice. Mechanical testing, analysis of iron, steel and refractory materials.

Higher Metallurgy

(Honours Students).

Lecturer—Prof J. H. Andrew, D.Sc.

Lecture hour—Tuesdays, 9.30 to 10.30 a.m.

Syllabus.

Recent developments in foundry metallurgy from the standpoint of appliances and method of working.

Physical metallurgy of irons and cast steels.

Effect of additions of alloy elements on the constitution and properties of iron and steel in their cast and heat-treated conditions.

Uses of alloy cast irons. Growth of cast iron.

Mechanical Testing

Lecturer—R. T. Percival, B.Met.

Lecture hour—Thursdays, 9.30 to 10.30 a.m.

Syllabus.

Advanced mechanical testing of materials in tension and compression. Transverse, impact, hardness, fatigue and creep values with special reference to foundry alloys.

Physical Metallurgy of Non-Ferrous Foundry Alloys

(Honours students).

Lecturer—To be appointed.

Lecture hour—Fridays, 9.30 to 10.30 a.m.

Syllabus.

Physical and mechanical properties of non-ferrous alloys in their cast and heat-treated condition. Equilibrium system of industrial non-ferrous alloys.

Heat-treatment and ageing.

Anodic oxidation and dyeing of cast aluminium alloys.

Engineering Drawing and Design

Hours—Saturdays, 9.15 a.m. to 12.15 p.m.

Fees

Tuition fees—For degree and for associateship courses—£41 10s. per annum.

Registration fees—For degree students—£1 5s. per annum; for associateship students—£1 1s. per annum.

The registration fee entitles a student to the use of library (subject to the observance of the library regulations) and common rooms.

Athletics and social subscription—£2 10s. per annum.

All fees are payable in advance. Cheques should be made payable to the Registrar of the University.

Note.—To non-British students, *i.e.*, students from outside the British Empire, an additional 20 per cent. will be charged on all fees.

Scholarships Available for Foundry Students under Certain Conditions

Entrance.

Edgar Allen. (6).—£100 per annum for three years. Three restricted to "sons of workmen earning daily or weekly wages and foremen of workmen and managers."

Ezra Hounsfield Linley (2).—£50 per annum for three years, plus fees (if funds permit).

Sheffield Town Trustees (4).—£50 per annum for three years. Restricted to candidates educated in any Sheffield school.

Robert Styring—£50 per annum for not more than four years. Restricted to King Edward VII School, Sheffield.

Feoffees of the Common Lands of Rotherham.—£50 per annum for three years. Vacant every fourth session. Restricted to candidates educated in a Rotherham school and whose parents have resided in the County Borough of Rotherham for four years immediately prior to date of entry.

Technical Scholarships (2).—Tuition fees for three years, and in case of need, maintenance grant not exceeding £20 for the first year, £25 for the second year, and £30 for the third year.

Technical Studentships (4).—Tuition fees for three years.

Both the technical scholarships and studentships are restricted to candidates born within the City of Sheffield or resident therein for twelve months previous to award.

Ernest Adlington.—£70 per annum for three years. Offered triennially. Restricted to King Edward VII School, Sheffield.

Postgraduate.

Frederick Clifford.—About £50. Restricted to graduates of the University resident within a radius of 40 miles.

Cutlers' Company.—£100 (to be held abroad).

Ezra Hounsfield Linley.—£75 or more.

Mechanics' Institute.—£50, plus fees (offered every fourth session).

Robert Styring (4).—£100. Restricted to candidates whose parents have resided in Sheffield for not less than four years.

Alfred Tongue. — About £80 (offered biennially).

West Riding Research Grants.—Restricted to graduates of the University resident in the West Riding Administrative Area.

George Senior Research Fellowship.—£125.

Sheffield Town Trustee Fellowship.—£75.

Note.—The postgraduate scholarships and fellowships are awarded for one year.

1851 Exhibition Senior Studentships.—£400. Offered by the Royal Commissioners for the Exhibition of 1851 for competition among students of this and other Universities.

Pig-iron output in the Siegerland district of Germany, after advancing steadily from 19,930 tons in January to 28,809 tons in July, showed its first decline, to 24,218 tons, in August. Output for the first eight months of the year, at 203,900 tons, was 67.15 per cent. higher than in the same period of last year (121,983 tons). In the same two periods, pig-iron output in the whole of Germany advanced by 65.8 per cent.

A New Type of Core Stove

In recent years the design of core stoves has undergone many modifications, both as to the application of heat and facilities for handling. The very latest is a design evolved by Controlled Heat & Air, Limited, of 16, Grosvenor Place, London, S.W.1. The plant which is illustrated has been installed in one of the largest automobile foundries in the Midlands, but has every appearance of being eminently suitable for tackling the work made in an ordinary jobbing foundry. The stove shown in Figs. 1 and 2 is of the turntable type and is fired by town's gas. Temperatures up to 500 deg. Fah. (260 deg. C.) can be obtained and great attention has been given to the prevention of heat losses through radiation by incorporating very efficient insulation. This has the extra advantage of keeping the shop cool in summer. Gas consumption is particularly low owing to the system of hot-air re-circulation, which is the basis of this company's activities. The cores are taking from 15 to 20 min. to bake. The installation illustrated is 7 ft. high by 6 ft. wide by 4 ft. deep. Its compactness will be appreciated in those foundries where floor space is valuable. The turntable is divided into two halves, which allows one side to be loaded whilst the other half is inside the stove. As the turntable is mounted on greaseless ball bearings, it is easily rotatable by hand. Though in the plant illustrated the shelves all move together, in other models, more suited to jobbing foundries, they are independent. Temperature regulation is controlled by a thermostat on the gas supply.

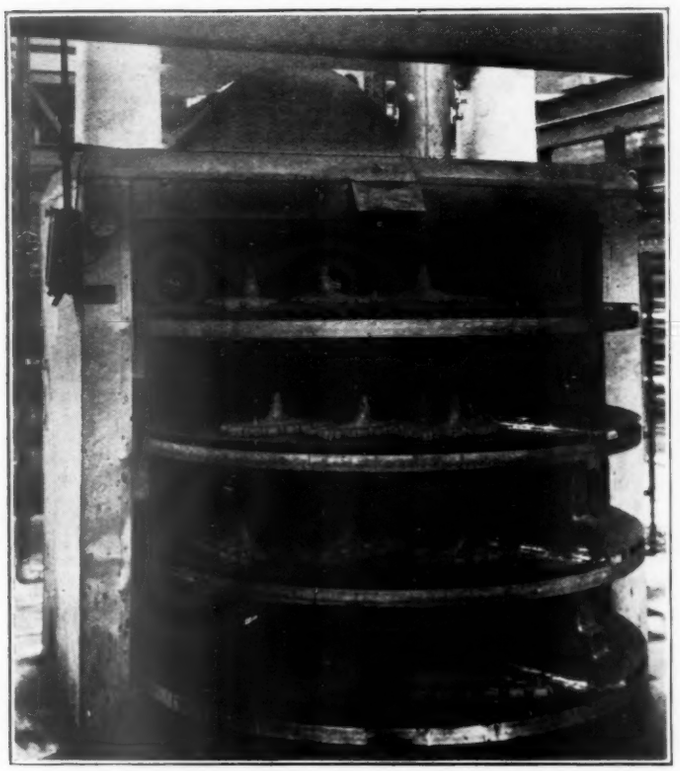


Fig. 1.—Front View of a New Type of Town's-Gas-fired Oven.

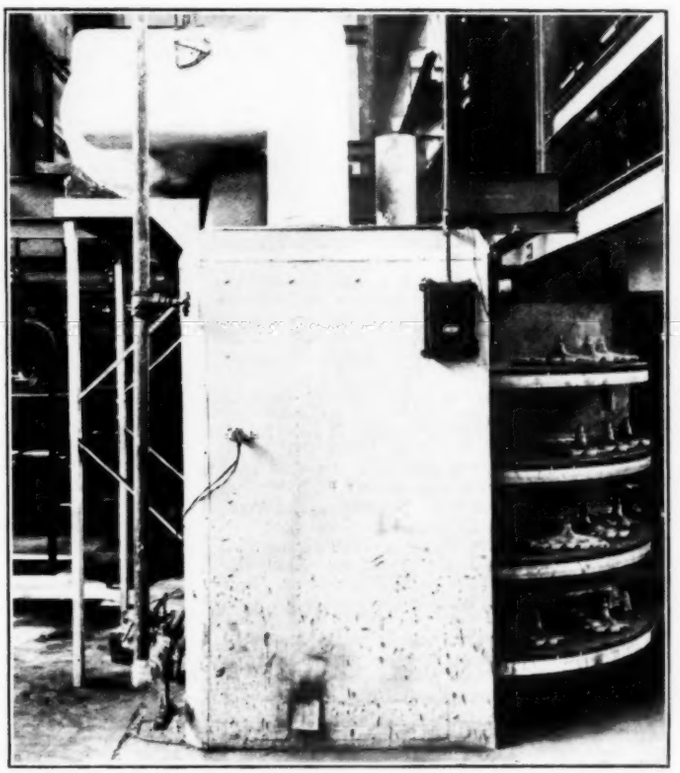


Fig. 2.—Side View of the New Core-drying Oven.

The Royal Metal Trades' Pension and Benevolent Society will hold its first dance of the season at Victoria Hall, Southampton Row, London, W.C.1, on Wednesday, October 17. Tickets (2s. 6d. each) can be obtained from any member of the Committee or from the Society's offices, 61, Knightrider Street, E.C.4.

Canadian Iron and Steel Industry

CONDITIONS IN 1933-34

The Report* on "Economic Conditions in Canada (1933-34)," by Mr. F. W. Field, C.M.G., H.M. Senior Trade Commissioner in Canada and Newfoundland, which has been published by the Department of Overseas Trade, points out in reference to the iron and steel industry that operations in that industry were still at a low ebb in April, 1933, but improved as the year progressed. The latter half of the year was responsible for two-thirds of the year's tonnage. The production of steel ingots and castings was 407,981 tons compared with 339,346 tons in 1932 and 672,109 tons in 1931. The 1933 tonnage was still far short of the figures of 1929 and 1930, when the tonnage was 1,378,024 and 1,009,578 respectively. The improvement last year over 1932 was 20 per cent. but the year's output was only 30 per cent. of that of 1929. The production of pig-iron last year was 259,645 gross tons compared with 160,291 in the previous year and 466,802 in 1931. The figures for 1929 and 1930 were 1,169,276 and 812,401 tons respectively. With the exception of 1932, the production last year was lower than in any year since 1900 and was confined largely to basic pig-iron for steel-making purposes.

At no period of the year was the productive capacity engaged beyond a limited percentage of the rated output. A unique experience was encountered in the cessation of all blast-furnace operations for a period of practically four months between February and June. The consumption of merchant pig-iron continues to be affected by the wider use of cast scrap, placed on the free list a few years ago, and by reason of the substitution of stampings, forgings and steel castings in place of iron. The iron foundries, however, through the use of alloying elements are improving the quality of castings produced, and it is hoped will regain some of the lost ground.

In spite of an increased demand prices in Canada either held firm or in some cases declined in recognition of the inability of consuming trades to meet with higher prices. The guiding policy in Canada has been in contrast with that followed in the United States where forced shortening of hours and higher rates of wages increased costs to an extent that higher prices were inevitable, particularly as few companies were able at the existing level to make sufficient profits to cover the usual depreciation charges. The detachment of the Canadian market prices for iron and steel from external influence is exemplified by the fact that, in spite of the swing in the value of the United States dollar from its highest premium, a 20 per cent. premium, to its lowest, a discount of over 3 per cent., no price changes were forced by the competitive influence of the United States market, even in lines subject to free entry.

* Report No. 587. H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. (Price 4s. 6d. net.)

Visit to Trafford Park Works

Members of the Manchester Association of Engineers paid a visit to the Trafford Park Works of the Metropolitan-Vickers Electrical Company, Limited, on September 19. They were first conducted to the gauge and tool rooms, and from there were taken through the automatic-machine department, the main electrical and mechanical aisles, the forge, and the foundries. The visitors also went through some of the laboratories of the Research Department, finishing in the high-voltage laboratory, where a high-voltage impulse discharge was demonstrated. Before leaving, the visitors took tea in the staff canteen and Mr. Power (President of the Manchester Association of Engineers) expressed the thanks of the Association to the company for their hospitality. He mentioned that the Constantine Gold Medal for the best Paper in the present session had been awarded to Mr. H. C. Young, the Assistant Superintendent of the Erection Department at Metropolitan-Vickers, for his Paper on "Some Power-Plant Erection Problems," and he recalled that some years ago Mr. G. E. Bailey (director) had won this medal. The Constantine Medal for the best Paper and the Butterworth Medal for the best contribution to the discussion had frequently been awarded to members of the M.-V. staff.

XUM

This Week's News in Brief

Trade Talk

Messrs. Yarrow & Company have received an order for a motor yacht of about 120 tons for an English owner.

A new mechanical coaling plant and a water-softening plant have been completed and brought into use at the Southern Railway's locomotive depôt at Stewarts Lane, Battersea.

It is understood that a big scheme of work on the River Medway is about to be launched, involving a total expenditure of £400,000. Dredging and land reclamation schemes are proposed.

The Monumental Brass Society, which was disbanded in 1914, has been revived this year under the presidency of the Rev. R. W. M. Lewis. A volume of the new Transactions is in preparation.

Deposits of hematite and siderite have been located in the Kielce district of Poland, at a depth of 60 ft. According to the reports of experts, these deposits cover an extensive area and contain a high proportion of rich iron ore.

The cruiser "Sydney" took the water from the yard of Messrs. Swan, Hunter & Wigham Richardson, Limited, at Wallsend, last week. The "Sydney" was laid down as the "Phaeton," but was taken over by the Australian Government and renamed.

Messrs. Robert Bowran & Company, Limited, bituminous paint manufacturers, etc., 4, St. Nicholas Buildings, Newcastle-upon-Tyne, announce an alteration of the title of the company to Robert Bowran & Company (1934), Limited, which took effect from October 1.

Sir William Larke, K.B.E., was the guest of the Scottish iron and steel trade at a complimentary dinner given in the North British Station Hotel, Glasgow, last week. Mr. John Craig, O.B.E., of Colvilles, Limited, was in the chair. Over 50 leading men in the industry were present.

Messrs. Glenfield & Kennedy, Limited, hydraulic engineers, Kilmarnock, have presented long-service medals to four of their employees. They were Messrs. James Thomson, Alexander Houston, William Hughes and William Clerk, all of whom had completed half-a-century's service with the firm.

A new standard colour scheme has been adopted by the L.M.S. Railway for the name-boards on station platforms. These will consist in future of a board painted yellow ground with the name and margins in black. Name-boards at a number of L.M.S. stations are already being painted to the new standard.

The Ministry of Transport has approved a scheme, submitted by Hull Corporation under the Public Works Facilities Act, for the improvement of the Victoria Pier at Hull. The improvement includes the erection of a hinged bridge at the Humber dock side of Victoria Pier to connect with a floating pontoon on the River Humber front.

Crackers, the Chinese symbol of peace and prosperity, were features of the launch of the single-screw steamer "Hai-Chen," which was built for the China Merchants' Steam Navigation Company by Messrs. Barclay Curle & Company, Limited. Madame C. C. Wang, wife of Dr. Wang, director of the Chinese Commission, performed the christening ceremony.

Company Reports

Vulcan Foundry, Limited.—Dividend on the ordinary shares of 2 per cent., tax free, for year.

Steel Company of Canada, Limited.—Dividend of 43¾ cents per share on the preferred stock and a similar dividend on the common stock.

Edgar Allen & Company, Limited.—Payment of the dividend on the 5 per cent. cumulative preference shares in respect of the half-year to September 30 is deferred. The preference dividend is in arrear from April, 1931.

Murex, Limited.—Net profit, £150,191; brought in, £44,150; preference dividend, £3,500; depreciation, £5,567; reserve for income tax, £25,190; to obsolescence reserve, £15,000; to staff pensions, £36,000; ordinary dividend of 35 per cent., £58,418; carried forward, £50,666.

Stewarts and Lloyds, Limited.—Payments for the half-year ended June 30, 1934, at the rate of 6 per cent. per annum on the cumulative first preference, 10 per cent. per annum on the cumulative second preference, and 5 per cent. per annum on the cumulative third preference.

United Steel Companies, Limited.—Net profit, £947,680; brought in, £230,380; to central reserve for depreciation, £275,000; reserve for taxation, £150,000; towards a staff provident fund, £25,000; dividend at the rate of 5½ per cent., less tax, £282,023; carried forward, £446,037.

Personal

Mr. H. A. Green, general manager of Murex, Limited, has been appointed to a seat on the board of directors of the company.

Mr. James Smith, President of the National Ironfounding Employers' Federation, and Mr. T. Makemson, general secretary of the Institute of British Foundrymen, sailed on Tuesday for the United States, where they will represent the Institute at the Philadelphia Congress.

Obituary

Mr. Robert Bamford, a director of Messrs. Bamford's, Limited, engineers, Uttoxeter, has died at the age of 69.

Mr. James B. King, retired patternmaker, has died at the age of 71. A few years ago he retired from his employment after almost 50 years' service with Messrs. Alexander Shanks & Son, Limited, with whom his father had been a patternmaker for many years.

Mr. R. Gordon Nicol, O.B.E., consulting engineer to the Fishery Board for Scotland, died recently. He was for over 35 years engineer to the Aberdeen Harbour Commissioners till his retirement in December, 1930, when he was appointed consulting engineer to the Commissioners.

Mr. Harry C. Pendleton, who retired this year from the position of managing director of the Middlesbrough Ship Repairing Company, Limited, has died suddenly, aged 63. He was formerly associated with Messrs. Richardsons, Westgarth & Company, Limited, Hartlepool and Middlesbrough.

Mr. Louis Henry Lavenstein, who from 1912 to 1919 was closely associated with the Union Steel Corporation of South Africa, eventually becoming business manager, has died in Johannesburg at the age of 69. Mr. Lavenstein played a prominent part in the development of the South African steel industry.

Manchester and District Ironfounders Employers' Association

Some of the members of the Manchester and District Ironfounders' Employers' Association spent a very enjoyable day in the Lake District recently. The entire party travelled by motor-coach to Lakeside, where they had lunch at the Lakeside Hotel. In the afternoon they covered the entire length of Lake Windermere by motor launch, arriving at Ambleside in time for afternoon tea. From there they went along the banks of Rydal Water to Grasmere, where a stop was made to visit the old church, which is rich with memories of Wordsworth. The party returned to Bowness, where a very handsome dinner was served at the Royal Hotel, after which the return journey was made to Manchester by coach. The outing had been carefully planned, and there was no hitch in the arrangements. The weather was excellent.

Manchester Ironfounders' Association Annual Outing.

The Institute of Vitreous Enamellers

(*Concluded from page* 206)

had been done in so short a time, work which had, through their getting together, resulted in the formation of The Institute. It was the need of the moment that they should not wait for others to take action for them, but get busy themselves. In conclusion, he would ask his fellow-guests to demonstrate that they were in agreement with him by the endorsement of a vigorous "Hear, hear." This the company readily did, and after the National Anthem had been sung an adjournment was made for dancing.

Supporting the President at the dinner were the following, in addition to those already named:—Mr. A. England, Mr. W. S. Grainger (Institute Treasurer), Mr. B. B. Kent, Mr. H. Bradley, Mr. H. M. Crankshaw, and Mr. H. Whittaker, while the secretary of The Institute (Miss E. C. Elliot) was present with Mrs. Mellor, Mrs. Whittle, Mrs. Amery, Mrs. Burman, Mrs. Rogers, Mrs. Roy Stubbs, Mrs. England, Mrs. Grainger, Mrs. Faulkner, and other ladies.

On the occasion of her forthcoming marriage, Miss Murial Gray, an employee of Messrs. James Keith & Blackman Company, Limited, High Street Engineering Works, Arbroath, was presented by her colleagues with a case of fish knives and forks. The presentation was made by Mr. H. A. Warden, chief clerk.

Wills

Kendrick, R. G. P., of Walsall, hardware manufacturer	£13,317
Oxley, Francis Keach, of Sheffield, cold-rolling-mill manager of Effingham Steel Works, Limited	£9,797

Forthcoming Events

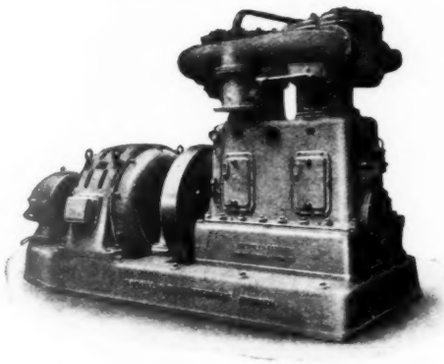
OCTOBER 11.

Institute of Metals:—Chairman's address by Mr. C. J. Smithells, M.C., D.Sc., Society of Motor Manufacturers & Traders, Limited, 83, Pall Mall, London, S.W.1, at 7.30 p.m.

OCTOBER 12.

Manchester Association of Engineers:—Presidential address by Mr. C. H. Power, Engineers' Club, Albert Square, Manchester, at 7.15 p.m.

COMPRESSORS
& DRY VACUUM PUMPS
FOR AIR OR GASES



These Vertical double-acting crosshead type compressors are built as single and two-stage machines for pressures up to 40 and 120 lbs. per sq. in. They are built in a range of sizes for capacities up to 10,000 and 5,000 cu. ft. per minute respectively.

See our Stand No. 18B at the MACHINE TOOL & ENGINEERING EXHIBITION at Olympia from November 8th—24th.

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Norwich Union Chambers,
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Telephone : Central 4038.
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FOUNDRY PHILOSOPHY

The Man who is "Quite Satisfied"

"Quite Satisfied" may be a negative state. It arrests progress and closes the door to future knowledge. In a rapidly moving and enquiring age no one should be eternally satisfied.

We know a man who was quite satisfied to use a sand of poor quality for years. His work was indifferent and he was a victim of his own limitations.

Never be satisfied unless you have proved the best of everything.
This stage will not be reached until you have used "ERITH LOAM."

The wise man when asked his supreme desire in life answered "A little more knowledge."
It will come to all Foundrymen after using "ERITH."

ERITH LOAM MARKETED IN FIVE GRADES :

MILD
MEDIUM
YELLOW
STRONG
EXTRA STRONG
and
WHITE SILICA
for Oil Cores

Samples on application to :—

J. PARISH & CO.
LOAM QUARRIES,
ERITH, KENT

Raw Material Markets

Business in the iron and steel markets has been rather limited during the past fortnight. Order-books are well filled, however, and there is no lack of optimism regarding home trade prospects for the winter. Conditions in the export markets are still difficult, and little material headway is being made in this direction.

Pig-Iron

MIDDLESBROUGH.—With well-filled order-books and a brisk home demand, producers of Cleveland foundry iron are in a strong position. Less is heard of Midlands competition in this market. There is little export business to be had, and quotations are consequently irregular. Home prices remain at the fixed levels, however, No. 3 Cleveland G.M.B. being quoted at 67s. 6d. per ton delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. delivered Glasgow. There are the usual differences for other grades, viz., No. 1 foundry 2s. 6d. per ton premium, No. 4 foundry and No. 4 forge 1s. per ton discount.

The output of East Coast hematite is well booked up until the end of the year, and the falling off in new business which has occurred since the increased prices were announced is therefore not regarded very seriously. The zones concerned are Middlesbrough and district, where the delivered price of No. 1 East Coast hematite is now 69s., North-East Coast, where the delivered price is 71s., Yorkshire 75s. to 78s., and London and the Southern Counties, where deliveries by rail are charged 83s. 6d. and by sea 69s. 6d. f.o.b., or 76s. per ton c.i.f. buyer's port. To all other districts quotations are unchanged and substantial deliveries, particularly to Sheffield and the Midlands, are providing continued employment for the blast furnaces.

LANCASHIRE.—Conditions in this market show little change, aggregate deliveries of iron into consumption having been satisfactorily maintained. For deliveries to foundries in this county, Staffordshire, Derbyshire, and Lancashire iron equal to Derbyshire quality are all quoted on the basis of 74s. per ton, with Northamptonshire at 72s. 6d., Derbyshire forge at 69s., and Scottish brands of No. 3 at about 82s. 6d. With regard to hematite, East Coast brands in this zone have not been affected by the recent advance, and offers are still on the basis of 76s. per ton, delivered, for No. 1 grade and 75s. for No. 3. On the other hand, West Coast material has been reduced by about 2s. per ton, offers now being at about 78s. 6d. per ton, delivered Manchester.

MIDLANDS.—The volume of new orders for pig-iron coming forward from this area has been limited, the reason being that the majority of the iron-founders are covered for three or six months ahead at to-day's rates, which are:—67s. 6d. per ton for Northants No. 3 and 71s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, including delivery to Birmingham and Black Country stations, plus 11d. for delivery into works in 10-ton lots. Scottish No. 3 and other low-phosphorus irons are quoted between 85s. and 87s. 6d., medium-phosphorus pig from 72s. 6d. to 80s., and for Diesel-engine and similar classes of work where special refined irons are used, £5 10s. to £6 15s. per ton is quoted. West Coast and East Coast hematite quotations are controlled at £4 4s. 6d. and £3 18s. per ton respectively for No. 3 grade, delivered this area, but Welsh hematite remains outside control, and is offered at slightly under the East Coast rate.

SCOTLAND.—The price of Scottish No. 3 foundry iron remains at the fixed minimum price of 70s. f.o.t. furnaces, with 2s. 6d. extra for No. 1. The light-castings makers remain very busy, and there is consequently a strong demand for Cleveland iron. The latter continues to be quoted at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow for No. 3 foundry, with No. 4 foundry 1s. per ton less.

Coke

Quotations for foundry coke are very firm, and there are suggestions of a rise. The majority of the larger consumers, however, have already taken cover for the winter at about the existing price levels. Current quotations for delivery in the South Staffordshire area are 36s. to 40s. for best Durham coke, 37s. 6d. to 45s. for Welsh and 40s. to 41s. per ton for Scottish coke.

Steel

Steady conditions rule in the steel market. While the home trade is maintained at recent levels, the export markets have shown signs of expansion. The tone of the market is confident, and it is generally expected that the volume of business will increase during the present quarter. Rather more active conditions have developed in the semi-finished steel department, and although many consumers are carrying substantial stocks and others have covered their requirements for some time ahead, a fair volume of business is being transacted. Lately foreign suppliers have not competed so strongly for business in the home market, but their quotations are still well below those of the British maker. In the finished-steel department, business has shown a distinct tendency to broaden, and overseas buyers have displayed more interest. Some important business has been transacted with the Far East. The demand from home consumers is absorbing considerable quantities of steel of all descriptions, and the steelworks are entering the third quarter of the year with a good tonnage of orders upon their books.

Scrap

There has been an improved demand for scrap iron on the Cleveland market, 50s. being paid for ordinary heavy cast iron, 52s. 6d. for good machinery quality and about 41s. per ton for light metal. There is a consistent demand for scrap iron on the Midlands market, prices paid averaging 55s. for heavy machinery metal, 50s. for good heavy pipe and plate and 47s. 6d. for clean light, all delivered works. In South Wales there is a steady call for heavy cast iron in large pieces and furnace sizes at 47s. 6d. to 48s. 6d., but there is only a limited demand for machinery grade, in foundry sizes, at about 52s. 6d. per ton. In Scotland, heavy machinery cast-iron scrap remains around 55s., with ordinary cast iron 51s. 3d. per ton, delivered consumers' works.

Metals

Copper.—The value of copper has continued its downward course, the standard quotation on the London market this week touching a record low level. Whilst the British demand remains fairly stable, there have been disquieting developments abroad. In Germany, the national consumption of copper for domestic purposes during the current quarter is to be reduced by 50 per cent., as compared with the last three months, according to a new decree. In the United States, the copper producers are further curtailing the amount of metal they are putting on their domestic market, in the endeavour to counteract the serious fall in consumption. In the meantime, the U.S. mines are exerting increased selling pressure in the export markets.

Daily market prices :—

Cash.—Thursday, £27 8s. 9d. to £27 10s.; Friday, £27 6s. 3d. to £27 7s. 6d.; Monday, £27 to £27 1s. 3d.; Tuesday, £26 16s. 3d. to £26 17s. 6d.; Wednesday, £26 6s. 3d. to £26 7s. 6d.

Three Months.—Thursday, £27 13s. 9d. to £27 15s.; Friday, £27 11s. 3d. to £27 12s. 6d.; Monday, £27 5s. to £27 7s. 6d.; Tuesday, £27 2s. 6d. to £27 3s. 9d.; Wednesday, £26 12s. 6d. to £26 13s. 9d.

Tin.—Whilst values of all other metals have fallen, the price of tin has been steadily pushed upwards by the efforts of the controlling organisation, to a level which may accelerate the change-over to substitutes. There has been an artificial scarcity of prompt supplies on the London market, which is serving to keep up the price at an arbitrary level; consequently, little business has been done with consumers.

Price fluctuations :—

Cash.—Thursday, £231 5s. to £231 10s.; Friday, £231 10s. to £231 15s.; Monday, £231 15s. to £232; Tuesday, £231 10s. to £231 15s.; Wednesday, £231 5s. to £231 10s.

Three Months.—Thursday, £227 15s. to £228; Friday, £228 10s. to £228 15s.; Monday, £228 10s. to £228 15s.; Tuesday, £228 10s. to £228 15s.; Wednesday, £228 10s. to £228 15s.

Spelter.—There has been a fair demand for this metal, but no sign of a recovery in price.

Messrs. Brandeis, Goldschmidt state that "reports have been current of some dissatisfaction within the Zinc Cartel. This is not altogether surprising seeing that internal difficulties of an economic character in some countries make it almost impossible for producers to adhere to an international agreement and to work within the quotas decided upon at a time when these difficulties were not in existence. The International Zinc Cartel has in the past been run on sound lines in so far as liberal supplies were always available, and it is to be hoped that some new and sound basis will be found to prevent a disorganisation of the market."

Day-to-day quotations :—

Ordinary.—Thursday, £12 10s.; Friday, £12 10s.; Monday, £12 3s. 9d.; Tuesday, £11 18s. 9d.; Wednesday, £11 16s. 3d.

Lead.—There has been a good demand for lead in this country, and Empire metal remains at a good premium. In addition, however, there have been heavy arrivals of foreign lead, which have served to keep down values.

Price fluctuations have been as follow :—

Soft Foreign (Prompt).—Thursday, £10 12s. 6d.; Friday, £10 10s.; Monday, £10 7s. 6d.; Tuesday, £10 5s.; Wednesday, £10 2s. 6d.

MESSRS. SMITH & WELLSTOOD, LIMITED, iron-founders, Bonnybridge, are to restore the cuts made in moulders' wages in 1931 one month before the time agreed upon by the conference of the men's union and the Employers' Federation. Messrs. Mitchell, Russell & Company, Limited, another Bonnybridge foundry, are to follow the same procedure. The wage-cut was to have been restored in November, but will now take place this month. To show their appreciation, the men in both foundries have agreed that the first week's restoration should be sent to the Wrexham Colliery Disaster Fund.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
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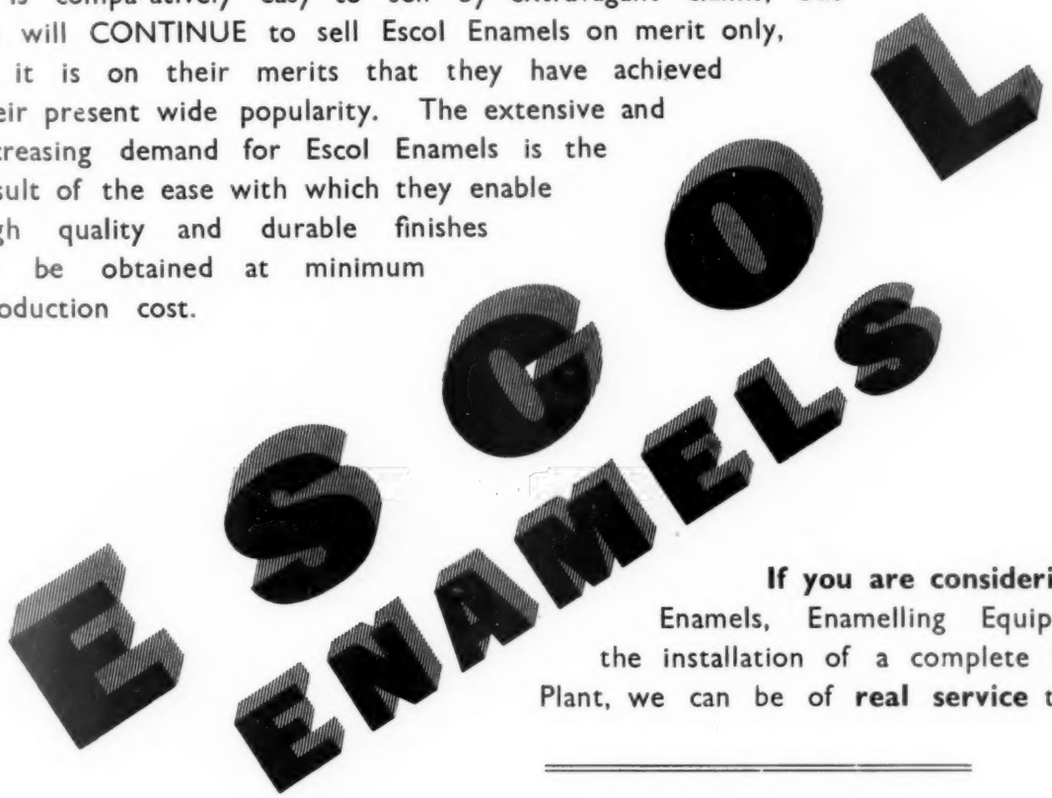
WE DO NOT BELIEVE IN THE DOCTRINE OF "SALES REGARDLESS."

It is comparatively easy to sell by extravagant claims, but we will CONTINUE to sell Escol Enamels on merit only, as it is on their merits that they have achieved their present wide popularity. The extensive and increasing demand for Escol Enamels is the result of the ease with which they enable high quality and durable finishes to be obtained at minimum production cost.



If you are considering Enamels, Enamelling Equipment, or the installation of a complete Enamelling Plant, we can be of **real service** to you ! ! !

WE SUPPLY PROVED EQUIPMENT AND REQUISITES COVERING EVERY REQUIREMENT OF THE VITREOUS ENAMELLER ! ! !

WE INVITE YOUR ENQUIRIES for the new types and most efficient Spraying and Sandblasting Equipments, Grinding Mills, Furnaces, Charging Machines, Drying Equipment, Perrets, Fusing Jigs, and all small tools, etc.

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5, VICTORIA STREET, LONDON, S.W.I.

Telephone : VICtoria 5794. **Telegrams : "Grayasons, Sowest, London."**

Sole Manufacturers of Escol Enamels :—J. F. Stewart & Co., Ltd., Paisley Works, Swain's Road, Tooting, London, S.W. 17

RAW MATERIALS—PRICE LIST

(Wednesday, October 3, 1934)

COPPER

	£	s.	d.
Standard cash	26	6	3
Three months	26	12	6
Electrolytic	29	10	0
Tough	28	10	0
Best selected	29	0	0
Sheets	58	0	0
India	39	10	0
Wire bars	29	15	0
Ingot bars	29	15	0
H.C. wire rods	32	5	0
Off. av. cash, September	27	11	6¾
Do., 3 mths., September	27	17	6
Do., Sttlmnt., September	27	11	10½
Do., Electro, September	30	15	8½
Do., B.S., September	30	13	1½
Do., wire bars, September	31	0	3
Solid drawn tubes			9½d.
Brazed tubes			9½d.
Wire			6½d.

BRASS

Solid drawn tubes	8¾d.
Brazed tubes	10½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7d.
Wire	7½d.
Rolled metal	6½d.
Yellow metal rods	4¾d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	231	5	0
Three months	228	10	0
English	231	10	0
Bars	233	7	6
Straits	231	7	6
Australian (nom.)	—		
Eastern	—		
Banca	229	10	0
Off. av. cash, September	233	0	0
Do., 3 mths., September	230	0	0¾
Do., Sttlmt., September	227	17	3
	230	1	0

SPELTER

	£	s.	d.
Ordinary	11	16	3
Remelted	13	0	0
Hard	13	0	0
Electro 99.9	10	2	6
English	14	10	0
India	13	5	0
Zinc dust	12	2	6
Zinc ashes	17	0	0
Off. aver., September	3	0	0
Aver. spot, September	12	14	10⅞
	12	12	10½

LEAD

	£	s.	d.
Soft foreign ppt.	10	2	6
Empire (nom.)	11	0	0
English	12	5	0
Off. average, September	10	10	0
Average spot, September	10	7	9

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	10	0
Do., V.M. ex whse.	22	7	6
Rods	26	10	0

ANTIMONY

	£	s.	d.
English	45	0	0 to 47 0 0
Chinese, ex-whse.	40	10	0
Crude	—		

QUICKSILVER

	£	s.	d.
Quicksilver	11	2	6 to 11 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 7 6
Ferro-vanadium — 35 50%	12/8 lb. Va.
Ferro-molybdenum— 70/75% carbon-free	5/6 lb. Mo.
Ferro-titanium— 23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten— 80/85%	3/- lb.
Tungsten metal powder— 98/99%	3/3 lb.
Ferro-chrome— 2/4% car.	£29 15 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome— Max. 2% car.	£36 0 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium— 96/98%	2/5 lb.
Ferro-manganese (net)— 76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese— 94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	15	0
Bundled shrngs.				2	7	6
Mixed iron and steel	2	10	0 to	2	12	0
Heavy cast iron	2	7	6 to	2	8	6
Good machinery				2	12	6
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	15	0
Cast-iron borings				1	5	0
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	10	0 to	2	12	6
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				2	17	6
Steel turnings, f.o.r.				1	13	0
Scotland—						
Heavy steel	2	10	0 to	2	12	6
Ordinary cast iron				2	11	3
Engineers' turnings				2	0	0
Cast-iron borings	1	18	6 to	2	0	0
Wrought-iron piling				2	11	3
Heavy machinery				2	15	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	25	0	0
Brass	16	10	0
Lead (less usual draft)	9	10	0
Tea lead	7	0	0
Zinc	9	0	0
New aluminium cuttings	66	0	0
Braziery copper	22	0	0
Gunmetal	22	0	0
Hollow pewter	145	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	69/-
Hematite M/Nos.	68/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	10	0 to	8	0	0
Hoops	10	10	0 and up.			
Marked bars (Staffs) f.o.t.	12	0	0			
Gas strip	10	10	0 and up.			
Bolts and nuts, ¾ in. × 4 in.	14	0	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	0	0 to	8	10	0
Chequer plts.	10	7	6			
Angles	8	7	6			
Tees	9	7	6			
Joists	8	15	0			
Rounds and squares, 3 in. to 5½ in.	9	7	6			
Rounds under 3 in. to ⅜ in. (Untested)	8	12	0			
Flats—8 in. wide and over	8	12	6			
,, under 8 in. and over 5 in.	8	17	6			
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)	9	7	0			
Black sheets, 24g. (4-t. lots)	10	10	0			
Galv. cor. shts. (,,)	13	0	0			
Galv. flat shts. (,,)	13	10	0			
Galv. fencing wire, 8g. plain	14	10	0			
Billets, soft	5	10	0 and up.			
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	2	6 to	5	10	0
Tin bars	5	2	6 to	5	7	6

PHOSPHOR BRONZE

	Per lb. basis.
Strip	9d.
Sheet to 10 w.g.	10d.
Wire	11½d.
Rods	10d.
Tubes	13d.
Castings	11d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.25
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	20/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box		18/2
,, 28×20	,,	36/4
,, 20×10	,,	26/- to 26/1½
,, 18¾×14	,,	18/7½ to 18/9
C.W. 20×14	,,	15/7½
,, 28×20	,,	33/6 to 33/9
,, 20×10	,,	22/9 to 23/-
,, 18¾×14	,,	16/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 0 0 to £16 10 0
Bars and nail-rods, rolled, basis	£15 15 0 to £16 0 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£30 0 0 to £31 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

XUM

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
Sept.	27 ..	27	8	9	No change
,,	28 ..	27	6	3	dec. 2/6
Oct.	1 ..	27	0	0	,, 6/3
,,	2 ..	26	16	3	,, 3/9
,,	3 ..	26	6	3	,, 10/-

Electrolytic Copper

		£	s.	d.	
Sept.	27 ..	30	5	0	dec. 10/-
,,	28 ..	30	5	0	No change
Oct.	1 ..	30	0	0	dec. 5/-
,,	2 ..	30	0	0	No change
,,	3 ..	29	10	0	dec. 10/-

Standard Tin (cash)

		£	s.	d.	
Sept.	27 ..	231	5	0	dec. 32/6
,,	28 ..	231	10	0	inc. 5/-
Oct.	1 ..	231	15	0	,, 5/-
,,	2 ..	231	10	0	dec. 5/-
,,	3 ..	231	5	0	,, 5/-

Tin (English ingots)

		£	s.	d.	
Sept.	27 ..	231	10	0	dec. 30/-
,,	28 ..	231	10	0	No change
Oct.	1 ..	231	15	0	inc. 5/-
,,	2 ..	231	15	0	No change
,,	3 ..	231	10	0	dec. 10/-

Spelter (ordinary)

		£	s.	d.	
Sept.	27 ..	12	10	0	No change
,,	28 ..	12	10	0	,, ,,
Oct.	1 ..	12	3	9	dec. 6/3
,,	2 ..	11	18	9	,, 5/-
,,	3 ..	11	16	3	,, 2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
Sept.	27 ..	15	1	3	dec. 1/3
,,	28 ..	15	1	3	No change
Oct.	1 ..	14	17	6	dec. 3/9
,,	2 ..	14	12	6	dec. 5/-
,,	3 ..	14	10	0	,, 2/6

Zinc Sheets (English)

		£	s.	d.	
Sept.	27 ..	23	10	0	No change
,,	28 ..	23	10	0	,, ,,
Oct.	1 ..	23	10	0	,, ,,
,,	2 ..	23	10	0	,, ,,
,,	3 ..	23	10	0	,, ,,

Lead (English)

		£	s.	d.	
Sept.	27 ..	12	10	0	No change
,,	28 ..	12	10	0	,, ,,
Oct.	1 ..	12	10	0	,, ,,
,,	2 .	12	5	0	dec. 5/-
,,	3 ..	12	5	0	No change

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	0 2 6	0 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 6 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	8 10 0	8 8 9	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 6 0	8 7 6	8 6 1½
1934	8 8 1½	8 10 7½	8 16 6	8 17 6	8 6 3	8 6 3	8 5 7½	8 5 0					

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOREMAN Coremaker seeks change: vast experience in large and small castings, motor and industrial engines; keen rate-fixer; supervision of male and female labour; good results and output guaranteed; good organiser. —Box 914, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager, desirous of a change, offers his services to employers who are in need of a live man who is not cheap but can do his job and produce castings of any weight to any specification required at a minimum cost. Efficient cupola control and high-class iron a speciality.—Particulars and terms to Box 916, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNMAKER, exceptional ability, moulding shop, drawing and estimating office experience, seeks position as Foreman. Sound technical knowledge modern methods. Educated and keen.—Apply, Box 906, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

IRON Foundry in London district require a Foreman for light and medium castings. Only first-class, fully-experienced men need apply, with good practical knowledge of sand and cupola control, and fully acquainted with all modern moulding methods.—Box 910, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

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